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Radar Scope photograph of New York City, taken from a B-17 by M.I.T. Radiation Laboratory staff members. This photograph was taken with new high definition apparatus which was designed for use against Japan and would have provided radar identification of important military objectives. The outline of Manhattan Island clearly shows the Hudson river with its shipping docks. The Metropolitan Museum can be seen jutting out into Central Park. On the New Jersey side the Hackensack river is clearly visible. At the time the photograph was taken the plane was directly over the spot in the center of the circle. Distance is indicated by the concentric circles used for navigation and bombing.

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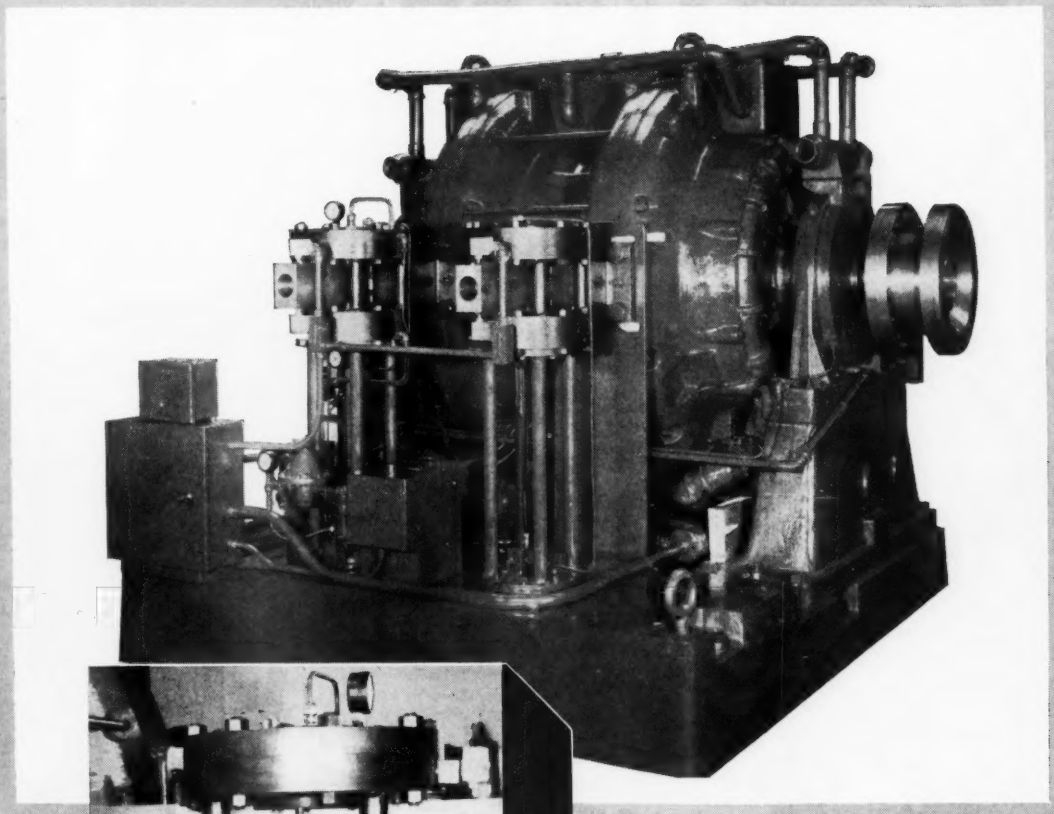
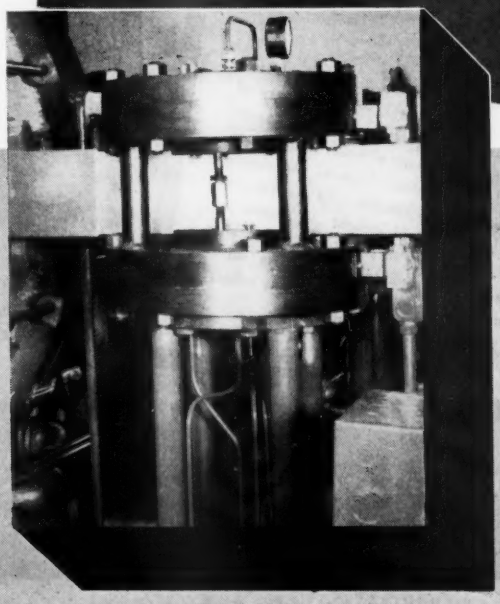
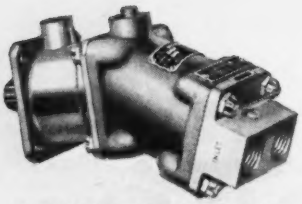




Upper photograph shows a THRUSTORQ and dynamometer set-up as used in one of the major airplane engine factories. Below is a close-up view of the THRUSTORQ showing how diaphragms above and below the shaft make it possible to measure either right-hand or left-hand torque.



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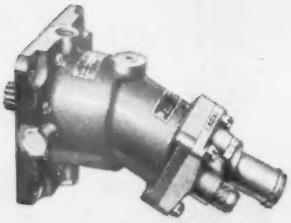

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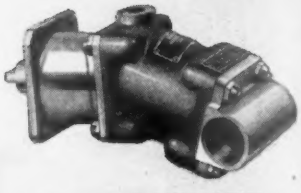

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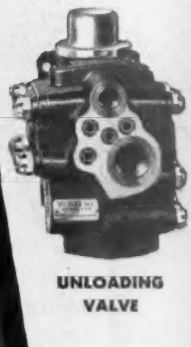

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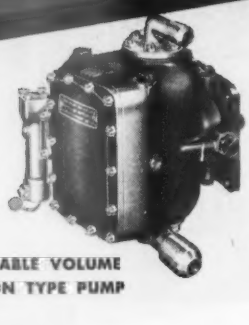

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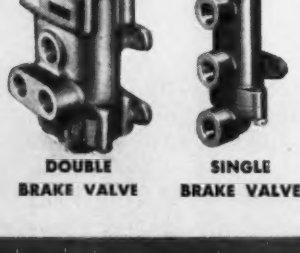

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Relation of Air-Line Operations to Transport Design

EDWARD PAYSON HALL*

Curtiss-Wright Corporation

Introduction

AIRPLANE ENGINEERS find themselves today in the same relative position as the automobile engineers found themselves some 15 years ago. In the initial stage of development of the automobile, the efforts of those pioneer designers were directed almost exclusively toward solving problems dealing with the automobile as a mechanism. As many of the mechanical problems were solved and the industry grew, the designers found the time and energy to include the utilitarian factors as an integral part of their basic design problem. As a result, the modern automobile accurately fills the requirements of the owner. It is a reliable and economical vehicle, easily handled in traffic, and comfortable for making long trips.

Similarly, up to the present time, the efforts of the airplane designers have been largely monopolized by the basic problems of flight-control, stability, performance, aerodynamic efficiency, types of construction, and so forth. Now that notable progress has been made in this direction, the designer can somewhat relax his concentration on these factors and can and *must* devote increasing attention to those problems that deal with the utilitarian features of the transport airplane.

It is the premise of this paper that the relation of air-line operations to transport design must be carefully considered and that intensive effort must be directed (1) to arrive at a thorough understanding and appreciation of the operating problems, (2) to the gathering of actual facts of past and present air-line operations, (3) to analyze these facts and evaluate them in terms of present and future basic design problems, and (4) to consider the utilitarian features together with the technical aspects from the inception of the preliminary design.

Only in this way can the proper provisions be made in the design so that the airplane is accurately suited to the service for which it is intended and, also—extremely important—only in this way can the proper evaluation of interrelated functions be made in the inevitable compromises necessary in a mechanism so complicated as the airplane.

Received December 21, 1944. To have been presented at the I.A.S. Thirteenth Annual Meeting, which was canceled to cooperate with a Government appeal (January, 1945) to refrain from holding conventions and meetings.

* Staff Engineer, Transport Analysis Section. Now Senior Engineer, Transcontinental & Western Air, Inc.

Evaluation of Design Factors

In order to properly evaluate the multitude of interrelated problems involved in transport airplane design, it is essential that some yardstick be developed by means of which any and all of the factors can be measured both relative to one another and relative to the airplane as a whole. The criterion used should, in so far as possible, be free of personal opinion and capable of application of the basis of sound fact.

It is suggested that "Profit-Earning Capacity" is such a criterion.

The profit an airplane can earn is dependent on two factors: (1) the revenue attracted and (2) the cost of operation. With a moment's reflection, one will recognize that even the apparently intangible element of safety can be measured by this criterion, since an airplane with a conspicuously poor record of safety will encounter a reduction in capacity to attract revenue.

This Profit-Earning Capacity will serve in evaluating not only the utilitarian factors but also the technical factors as well. For example, the higher the aspect ratio, the lower the drag; but the higher the aspect ratio, the greater the weight. The optimum compromise will therefore be that aspect ratio that results in the greatest Profit-Earning Capacity for the airplane in the type of service for which it is intended.

Such a criterion may properly replace those heretofore used in judging the excellence of a transport airplane. No longer should pay load or high speed alone be used as a measure of worth as these are merely components of the ultimate criterion. These factors must hereafter be evaluated with respect to their effect on the Profit-Earning Capacity of the airplane.

The various elements that together constitute an air liner are intimately interrelated. It is not possible to examine one factor, or even two conflicting requirements, and make the proper compromise as one proceeds. It is the sum total of all of the factors, properly balanced against one another, that make up the airplane design. A criterion that can be used to achieve this important balance of design is an invaluable tool.

Utilitarian Factors

In the evaluation of utilitarian factors, it is often as difficult to determine the quantity to be measured as it is to measure the quantity itself. What are the considerations involved in determining the optimum weight of soundproofing to be installed? What decrease in noise level will attract sufficient revenue to offset the reduced pay load due to increased weight empty? What is the value of reducing pilot and passenger fatigue? How is it to be measured? How much weight can be added to reduce this factor? Will increase in speed resulting from use of higher cruising power be justified by the increase in ability to attract revenue? The measurement of these, as well as the many other quantities involved, and the interpretation of these measurements in terms of the design problem is a science in its own right.

Future Design Requirements

The forecasting of *future* design requirements is a particularly important function which this analysis of operating data can perform. When the design of a new model is started, it is anticipated that the useful life of the airplane will not end for many years. About 4 years elapse between the inception of the preliminary design and the actual use of the first unit in commercial operation. Also, the high initial cost of the modern transport airplane, coupled with a large investment in ground equipment and in the training of personnel, necessitates a long-term write-off of the initial investment. It is clear, therefore, that the basic design must be such that the airplane will fit into the rapidly changing air transport picture during a period of from 4 to 10 years or more after the start of the design development. Manifestly, with millions of dollars invested in the development of a single transport airplane, accurate forecasting of future design requirements is of paramount importance.

In order to clarify the potentialities of this method of attack, examples will be discussed which will illustrate the way in which the design will be affected and the gains that may be expected thereby. Of the many factors that influence the Profit-Earning Capacity of an air liner, speed in scheduled operation and reliability in scheduled operation have been selected for discussion.

Speed in Scheduled Operation

If the scheduled speed of a transport airplane can be increased without increasing the cost of operation, the rev-

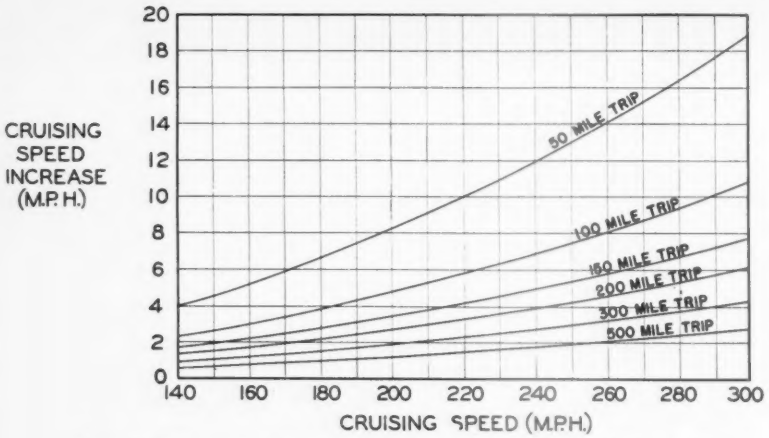

Fig. 1. Cruising speed increase necessary to reduce block time by 1 min.

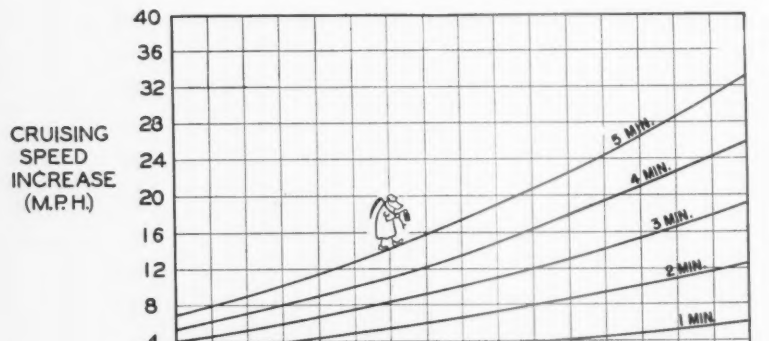

Fig. 2. Cruising speed increase necessary to reduce block time by various increments for 200-mile trip.

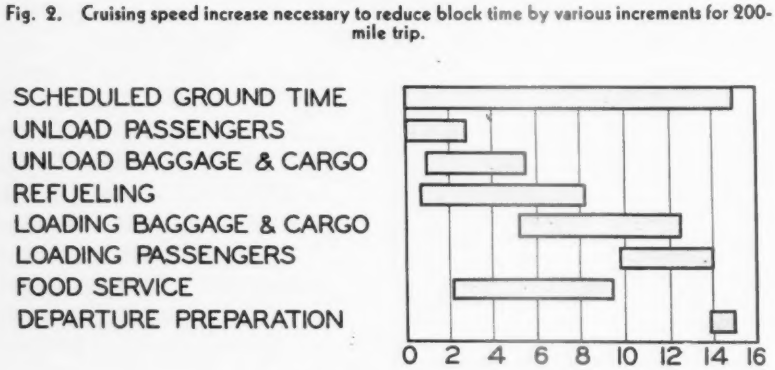

Fig. 3. Typical ground time.

enue-attracting ability and, therefore, the Profit-Earning Capacity, of the airplane is enhanced. A smaller premium need be paid by the passenger and shipper per unit of time saved over that required by surface transportation.

Speed in scheduled operation is partially dependent on cruising speed, of course, but scheduled speed is also dependent on scheduled ground time. An airplane with a higher cruising speed has no advantage over another airplane that is designed to permit shorter ground stops and is thereby capable of maintaining the same scheduled speed as the first airplane between any two terminal points with a given number of intermediate stops.

Fig. 1 shows for a twin-engined airplane the increase in cruising speed necessary to reduce the block time by 1 min. for different trip lengths. In other words, the value of saving 1 min. on the ground is shown in terms of cruising speed—a quantity easy for the aeronautical engineer to appreciate. For a two-engined airplane, with a 200-m.p.h. cruising speed, operated on a flight involving 50-mile trip lengths, the curves of Fig. 1 may be used to show that 1 min. saved on the ground is equivalent to increasing the cruising speed to 208.2 m.p.h. The saving of a single minute of time on the ground in this example produces 8.2 m.p.h. of "go-grease," as Benny Howard calls it.

The curves show clearly the increasing importance of ground time reduction as the cruising speed is increased and the trip length shortened. The type of service for which the airplane is designed has, therefore, a decided bearing on how far the designer should go in reducing ground time.

The average trip length for present-day domestic air lines is approximately 200 miles. Fig. 2, which is an elaboration of Fig. 1, shows the necessary increase in cruising speed for a 200-mile trip to reduce the block time by 1, 2, 3, 4, or 5 min.

As will be shown later in this paper, a study of air-line operational data reveals that, for some of the longer ground stops, a saving of at least 5 min. can be realized by the proper consideration during the design of the airplane of operational requirements on the ground. On the basis of a 5-min. reduction in ground time, an airplane with a 250-m.p.h. cruising speed operating on a 200-mile trip, must increase its cruising speed by 22.6 m.p.h. to effect an equal saving by brute force!

To determine how the airplane design should be modified to reduce ground time and thus increase the Profit-Earning Capacity of the airplane, it is necessary to analyze the operations performed during a normal scheduled stop. Fig. 3 shows the allocation of time for each operation during a typical scheduled stop of 15 min. on a flight involving 250-mile trips with the present-day two-engined transport.

Time involved in dispatching the airplane has been omitted from the figure as this subject will be discussed in detail later.

From Fig. 3, it is obvious that the scheduled ground time could be reduced by shortening the time required for the critical operations or by starting the critical operations more quickly, or by a combination of both. It is equally obvious that shortening any one operation will, by itself, result in little or no saving in ground time. For example, reduction in refueling time will be of no benefit unless in so doing the loading of baggage, cargo, and passengers can be started sooner.

If the airplanes were designed to permit it and if the air line had a large enough ground crew, all operations except passenger loading could start simultaneously the instant the airplane came to rest at the ramp. With the addition of time required for departure preparation, the airplane could be on its way less than 9 min. after arriving. This would constitute a 6-min. reduction without actually shortening any single operation! The ground time breakdown for this type of operation is shown in Fig. 4.

In order to increase the Profit-Earning Capacity of the airplane by reduction in ground time, the increase in

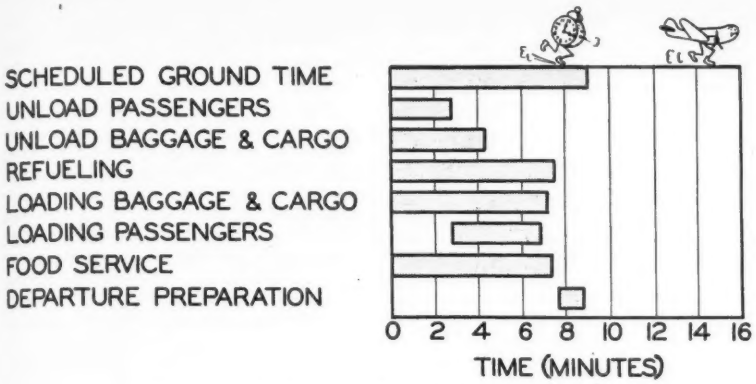

Fig. 4. Ground time possible with improved design.

revenue-attracting ability must be more than enough to offset any increase in operating cost resulting from the use of larger ground crews, lower pay load, and so forth. Further detailed study of air-line operations is therefore required to determine how much emphasis the designer should place on ground time reduction.

Air-line Operations

With the single entrance door now common to transport aircraft, the loading and unloading of passengers cannot be undertaken simultaneously. However, it is well to bring up the question as to whether or not it is *desirable* to have simultaneous loading and unloading of passengers. The major portion of time involved in loading passengers is used up in recalling passengers from the waiting room, ticket counter, and telephone booth. This is clearly illustrated by the difference in time for loading and unloading of passengers.

The passenger problem is primarily one of providing sufficient accommodations *within* the airplane to cause the through passengers to *prefer* to remain on the airplane during a stop. Lavatory and lounge facilities must be adequate and attractive. Perhaps the hostess' telephone handset can be connected to the local telephone circuit to provide for those passengers requiring phone service. The airplane must be roomy enough to permit the passenger ample leg room while seated, as well as sufficient space to move about and stretch his legs during flight. The often suggested scheme of providing motion pictures projected on the forward bulkhead might prove well worth the additional weight. It is believed that with careful consideration given to these factors, the passenger loading and unloading time can be reduced to the point where it will not be critical. On the railroad, where time is relatively of much less importance than on the air line, it is difficult to imagine the large majority of passengers getting off to stretch their legs at each stop.

The time involved in loading and unloading baggage and cargo can best be reduced by improving accessibility to the cargo and by providing adequate segregation of cargo into bins according to destination. The present cargo arrangement sometimes requires almost complete unloading to remove one piece of cargo from the bottom of the heap. The A.T.A. has suggested the use of baggage storage facilities in the cabin for passenger baggage. In effect, the passengers become a human conveyer belt, bringing their baggage piece by piece to the baggage handler. Even with this system it will be necessary to segregate baggage according to destination to prevent confusion and delay at way stations. If simultaneous loading and unloading of mail, express, and freight are to be accomplished, it will be necessary to have at least two cargo doors. It is quite possible that some increase in structural weight is justified to permit the addition of sufficient cargo doors to provide a separate, adjustable cargo compartment for each station. The doors must be large enough to permit free and rapid movement of handlers to allow unrestricted flow of cargo. The cost of increased structural weight would, of course, have to be balanced against the gain in scheduled speed for each design.

One of the most controversial problems confronting the airplane designer today is the height of cargo floor above the ground. The low cargo floor may or may not permit more rapid loading of cargo. The low cargo floor certainly requires increased structural weight and it is only by careful analysis of operational data that the proper solution to this problem can be found.

Reduction of refueling time involves providing easy accessibility to the filler necks, together with adequate provision for high capacity fuel flows and accurate means of measuring the quantity of fuel in the tank. On the larger airplanes where the top surface of the wing is high off the ground, it appears desirable to refuel from underneath the wing, but the additional weight and increased maintenance of such an installation must be checked against the reduction in servicing time. Certainly an accurate fuel-quantity gage at the filler neck is amply justified to eliminate the time-consuming operation of "sticking" the fuel tank, as was done years ago in the famous Model "T" Ford.

It is interesting to note that if the air lines are to use the larger transports for local operations, larger ground crews will be required. Due to the reduced frequency of the trips necessary to handle the available traffic with the larger equipment, the ground crews will be idle more of the time. It is for this reason that the larger the airplane, the more important are the considerations affecting ground time.

From the foregoing discussion, it is apparent that the utilitarian aspects of ground time bear an extremely important relation to the basic airplane design. Only by careful consideration of air-line operations can the airplane be designed to increase its Profit-Earning Capacity to the air line in this regard.

Reliability in Scheduled Operation

No matter how fast a transportation medium may be, unless it is dependable it cannot attract maximum revenue. Analysis of air-line operational data and the application of the profit-earning criterion are again necessary in order to determine the relationship of reliability in scheduled operation to the basic airplane design.

Reliability in scheduled operation concerns the ability of the airplane to arrive at the destination as scheduled. Delays in flight caused by headwinds, storms, etc., are of minor importance because the scheduled flight time is usually based on a cruising power low enough to allow for such contingencies. An additional allowance for maneuvering is added to the already conservative flight time. On-time arrival is therefore largely predicated on on-time departure.

Two main factors affect the ability of the airplane to depart and arrive as scheduled: (1) delays beyond scheduled ground time and (2) flight cancellations. In general, the causes of flight cancellations are the same as the causes of delays and it is largely a matter of degree as to whether the flight is delayed or cancelled.

Operational Delays

An analysis of delays has been made for two typical air-line flights covering operations for each day of the year 1943. One route, which covered a distance of somewhat over 1,200 miles and had eight intermediate stops, may be classified as a local trunk type. The other route, which was also slightly over 1,200 miles in length but had only three intermediate stops, may be classified

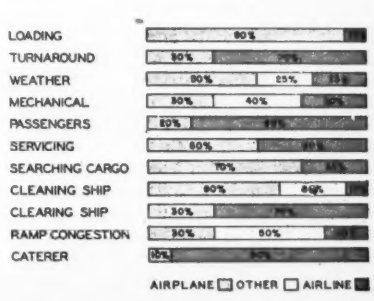

Fig. 5. Responsibility for various delays.

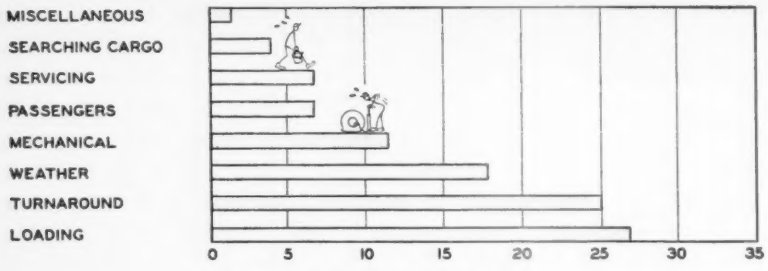

Fig. 6. Ground delays for local trunk trip.

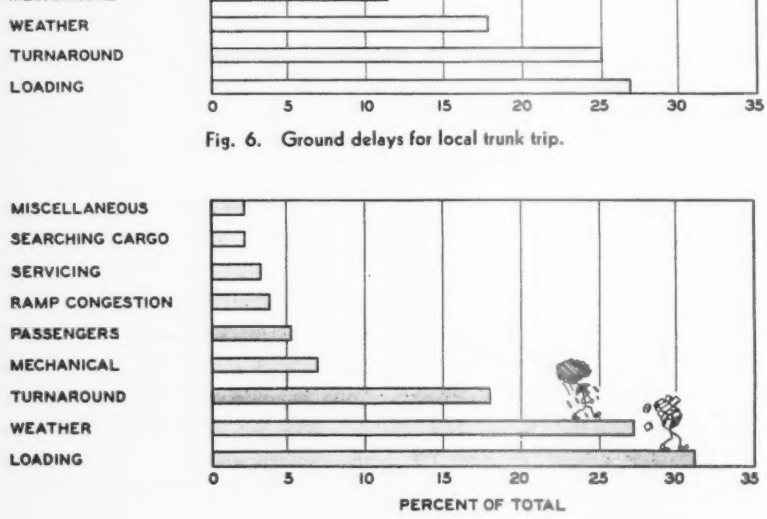

Fig. 7. Ground delays for limited express trip.

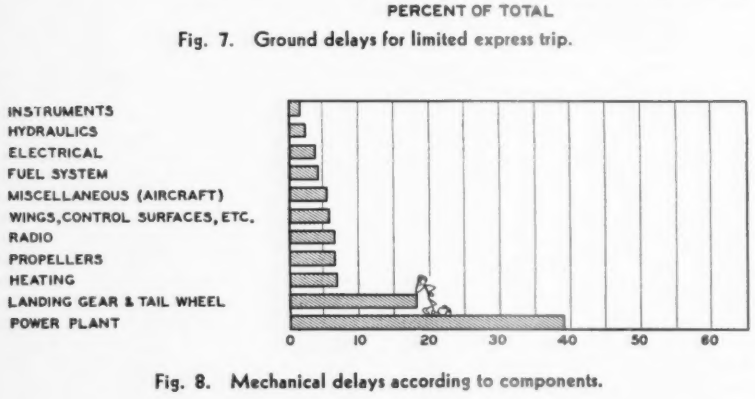

Fig. 8. Mechanical delays according to components.

as a limited express type. In each case two flights were included, one in each direction, to eliminate variables due to flight in one direction only.

The total delay time due to each cause was tabulated for the entire year. In cooperation with authoritative air-line officials, the responsibility for the delays was broken down to show the percentage attributable to the design of the aircraft, to the operational procedures of the air line, and to conditions beyond the control of either the airplane designer or the air-line operator. Fig. 5 shows the proportioning of the responsibility for the delays encountered.

Fig. 6 shows the delay time chargeable to the airplane design for the local trunk flight. Each delay is expressed in per cent of the total delay time chargeable to the airplane design.

Fig. 7 is similar to Fig. 6 except that the data presented are for the limited express service. The similarity of the data for these two figures is striking and appears to indicate that the same delay problems are involved in the design of all airplanes for the ranges commonly encountered in domestic operations.

The most important causes of delay are loading, turn-around, weather, mechanical, passengers, servicing, searching for cargo. Minor delay factors are cleaning the ship, ramp congestion, dispatching, and catering service.

If all of the delays chargeable to the airplane design were eliminated on the route from which data for Fig. 6 were taken, the air line would have secured an effective average increase in cruising speed of 4.2 m.p.h. for all flights of the two trips for the entire year! Reduction in operating time could have been accomplished with an accompanying reduction in operating cost due to increased airplane utilization.

Delay due to loading is partially tied up with critical balance considerations. It is frequently necessary to unload and reload cargo and baggage to secure a satisfactory center of gravity location to insure stability and controllability. Obviously, the permissible c.g. range and proximity of the disposable load to the c.g. are principal design factors to be considered in this regard. Rapid loading and unloading of cargo have previously been discussed in greater detail with regard to reduction of scheduled ground time, and the same factors are involved in reducing delays due to this cause.

Delays due to weather account for 18 per cent of the total delay time in the case of the flight with frequent stops and 27 per cent in the case of the limited express flight. The difference is largely accounted for by the fact that with frequent stops the air line can better afford to fly over one of the stops if unfavorable weather exists than in the case with the limited express type of service. In other words, a greater degree of flexibility of operation exists for the local trunk type of operation.

The elimination of delays due to weather will depend upon the development of suitable equipment to permit all-weather operation. Wartime developments hint at great progress in this direction. As is the case with the loading problem, the incorporation of equipment to permit all-weather operation must be considered at the time of inception of the basic design. Such equipment cannot properly be added as an afterthought.

Mechanical Delays

Elimination of mechanical delays chargeable to the airplane design appears to depend to a considerable degree upon mechanical perfection. The requirement of mechanical perfection is common to all machines: the railroad locomotive, the lawn mower, and the sewing machine, as well as the airplane. It is usually easier to evolve a complicated "Rube Goldberg" than it is to design a simplified and highly refined mechanism. The aeronautical engineer must boil his design down to its simplest elements, combining functions where practicable and omitting all frills.

The aeronautical engineer is also faced with the problem of achieving a fine balance between light weight and ruggedness of construction. If weight could be neglected it is conceivable that most of the aircraft components could be designed to operate without attention for the life of the airplane. However, such an airplane could carry little pay load, if, indeed, it could fly at all. It appears necessary, therefore, that the engineer design the components for a definite life depending on the service requirements of the particular part and the maintenance procedure of the operator. If a part is normally removed for inspection and test during a 2,500-hour major overhaul period, it may be desirable in the interest of Profit-Earning Capacity to design the part with a safe life of 3,000 hours and to replace it at each major overhaul. The life to be designed into each component will depend upon the cost of the part, the weight reduction possible in the part when designed for shorter life, and the operator's maintenance practices.

Fig. 8 shows a summary of mechanical delays for one of the major air lines for a period of 1 year. The breakdown shown is according to the principal

components of the airplane. Delays are expressed in per cent of the total mechanical delay for the year.

Fig. 9 has been prepared to show the data classified according to responsibility for the delays. For the purpose of this analysis, the term "accessories" is used in a broad sense to mean a part purchased by the airplane manufacturer and over which the airplane manufacturer has no control other than that of selection and installation. It is interesting to note that, according to this classification, accessories account for 63.5 per cent of all delays for this air line for the entire year. The specific causes of the individual delays were not recorded in sufficient detail to be positive that the proper allocation of the delay had been made. However, it is quite obvious that the allocation could be seriously in error without changing the obvious conclusion to be drawn: the airplane manufacturer and the airline operator must team up to provide the accessory manufacturer with the proper data to permit him to improve the suitability of his product. The airplane manufacturer must exercise the greatest care in the testing, selection, and installation of purchased components.

Part of the delay time caused by accessory failures is due to the airplane design. If accessories are installed in inaccessible places, thus requiring an unwarranted length of time for removal or repair, this naturally adds considerably to the total time charged to this cause of delay. The fact remains, however, that if the accessory had not failed in the first place the delay would not have been caused.

Only a small portion of the delays chargeable to the power plant, which seem to be so prominent in Fig. 8, is actually chargeable to the parts designed and produced in the engine manufacturer's plant. The engine, in this case, is considered to be the bare engine without the carburetor, ignition system, or other necessary accessories. Since the engines constitute approximately 15 per cent of the empty weight of the airplane, and are responsible for only 8.7 per cent of the mechanical delay time (see Fig. 9) or 1 per cent of the total delay time due to *all* causes, it may be concluded that the engines themselves constitute a minor factor in operational delay.

It is interesting to note that with the complete power-plant installation, including power-plant accessories, making up 39.2 per cent of the total mechanical delay, and with the mechanical delay accounting for 11.5 per cent of the total delay time, thus 4.5 per cent of the total delay due to all causes is chargeable to power-plant installation on a two-engined airplane. In a four-engined airplane it would be expected that the power-plant delays would jump to about 9 per cent of the total, other things being equal. Obviously, the greater the number of power plants, the more important are the design considerations of the power-plant installation.

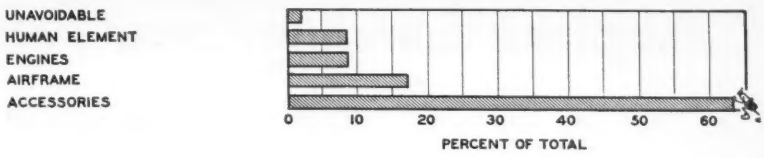

Fig. 9. Responsibility for mechanical delays.

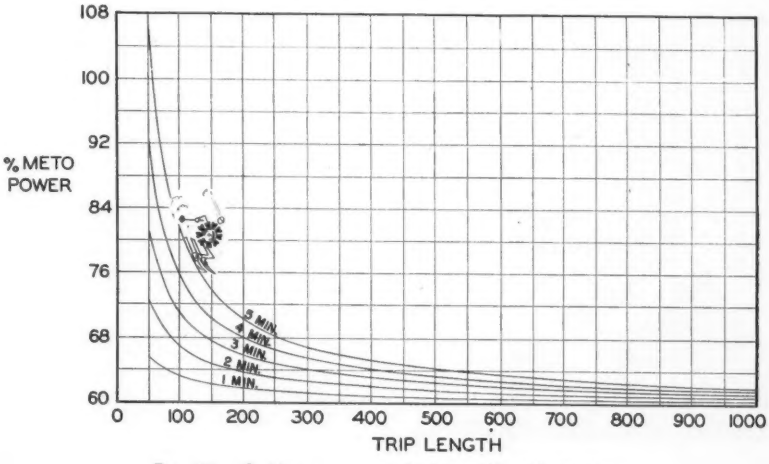

Fig. 10. Cruising power required to reduce block time.

Effect of Operational Delays on the Power Plant

The effect of power-plant troubles on operational delays has been shown and it is desirable now to turn the picture around to show the effect of operational delays on the power plant.

Although the effect of increased cruising power on engine overhaul and maintenance costs is not too well understood at the present time, most operators seem to agree that these costs increase rapidly as the cruising power is raised above 65 per cent of m.e.t.o. power. Some operators feel that costs start to rise sharply as the cruising power goes above 55 per cent of m.e.t.o.

Fig. 10 shows the increased cruising power required to shorten the block time by various increments of time for various trip lengths. These curves are particularly significant in view of the tendency of pilots to attempt to get back on schedule by the use of increased cruising power. On a 200-mile trip—the present-day average for domestic air lines—it would be necessary to fly at 65.8 per cent of m.e.t.o. power instead of 60 per cent to make up 3 min. time on the schedule. The curves shown in Fig. 10 are based on an airplane with a cruising speed of 218 m.p.h. at 60 per cent m.e.t.o. power at an altitude of 10,000 ft.

Fig. 10 also illustrates graphically that for airplanes designed to operate on trip segments up to about 300 miles in length, the reduction in scheduled ground time and ground delay time is of much greater importance than aerodynamic refinement. For trip lengths between 300 and 600 miles the ground and delay time is of about equal importance to aerodynamic refinement, and for trip lengths above 600 miles the gains to be expected through aerodynamic refinement far outweigh the gains to be made by utilitarian improvement.

Passenger Delays

Delays due to passengers amount to 6.7 per cent of the total delay time. However, the year 1943, for which these data were compiled, was a war year and the passenger delays undoubtedly occupy a much more prominent place than would be the case in a normal peacetime period of operation. Nevertheless, delays due to passengers deserve considerable thought because of the effect on reliability of scheduled operation.

In complying with past Civil Air Regulations, from 3 to 6 min. were required from the time the last passenger had checked in at the traffic desk until the airplane could be dispatched. Time was necessary to weigh and check the passengers' baggage, to determine the passengers' weight, to fill out the necessary passenger and baggage manifests, to add up the totals on pay loads, to figure the location of cargo for proper balance, and to load the passenger and his baggage.

To reduce delays caused by late arrival of passengers, many of the air lines attempt to have passengers check in at the traffic counter from 10 to 20 min. before flight time. While it is true that this practice will permit the airplane to depart at the scheduled time, it defeats the purpose for which it is intended. In reality, it does not decrease the time required for the passenger to get from one city to the next. This 10 to 20 min.-period does not show

(*Continued on page 21*)

Airplane Landing-Gear Fatigue Problems

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SUMMARY

This paper describes a number of service failures of landing-gear parts. These failures are believed to be due to low-cycle fatigue. Static, impact, and fatigue tests are described, with a description of test apparatus and methods.

It is shown that both fittings and primary structural members, with a static failing strength of 130 to 250 per cent of design ultimate load, will withstand only a few thousand cycles of limit load. Curves of load versus number of cycles to failure are presented, and it is shown that the limit load is well above the "knee" of the S-N curve.

The correlation between results from Stresscoat and electric strain gage tests and results from fatigue testing is illustrated. Effects of various means of strengthening parts subject to service failures are given, and an example is described in which a landing gear was designed to meet certain fatigue criteria.

The evidence presented is believed to warrant consideration of fatigue in design. This would require flight investigations of landing-gear loads and laboratory investigations of fatigue strength of various members.

INTRODUCTION

AIRCRAFT STRUCTURAL ENGINEERS are today confronted with the necessity of reconsidering accepted design requirements with a critical eye. Wartime experience has indicated that design requirements that formerly permitted a reasonable assurance of freedom from structural failures are no longer adequate. The designer and stress analyst have been accustomed to designing the airplane structure, by the usual methods of stress analysis, to a more or less arbitrary set of design conditions. These methods of analysis, together with certain static tests, have, in the past, provided airplane structures of reasonable satisfaction in service. Recent experience indicates that it is desirable to review (1) the design requirements and (2) the methods of verifying that a given aircraft structure will withstand the modified requirements.

The field indicated above is, of course, extremely broad, and it would be foolhardy for any one individual to attempt to cover this field. It is the purpose of this paper to consider only a portion of the airplane structure—namely, the landing gear. The scope is further restricted to a limited number of phases of the structural design problem. Specifically, this paper is concerned with the general problem of fatigue and is written in the hope of stimulating interest in this problem with a view toward accumulation and exchange of information leading to a more sound method of designing the landing-gear structure.

The weight of the landing gear constitutes 5 to 12 per cent of the structural weight of the modern airplane. Further, 47.6 per cent of all structural failures on commercial airplanes during 1940 were in the landing-gear structure. It is thus apparent that this structure, which is used only while this vehicle of the air is on the ground, should be the object of whatever effort is required to develop design criteria and techniques that will permit a minimum weight and a maximum freedom from failures. It is the author's belief that this effort should be directed along the lines of (1) determining the loads to which the landing gear is subjected and (2) obtaining information as to the allowable fatigue life of landing-gear components. It is believed that each of these phases is a long-range problem that will require the joint efforts of the armed services, the Governmental agencies, and the industry, in obtaining, coordinating, and interpreting experimental and service flight and laboratory data.

ORIGIN OF PROBLEM

The first evidence of fatigue failures in landing gears manufactured by Bendix Products to come to the attention of the Engineering Department was obtained in October, 1942. These failures occurred in a torque scissors fitting welded to the outer cylinder of the main gear shock strut of a medium patrol bomber. The landing gear was of the conventional tail-wheel type, and the main gear was semicantilevered, with offset wheel, as illustrated in Fig. 1.

The service failures occurred in the weld between the fitting and the cylinder barrel. The first such failure was not detected until a portion of the fitting

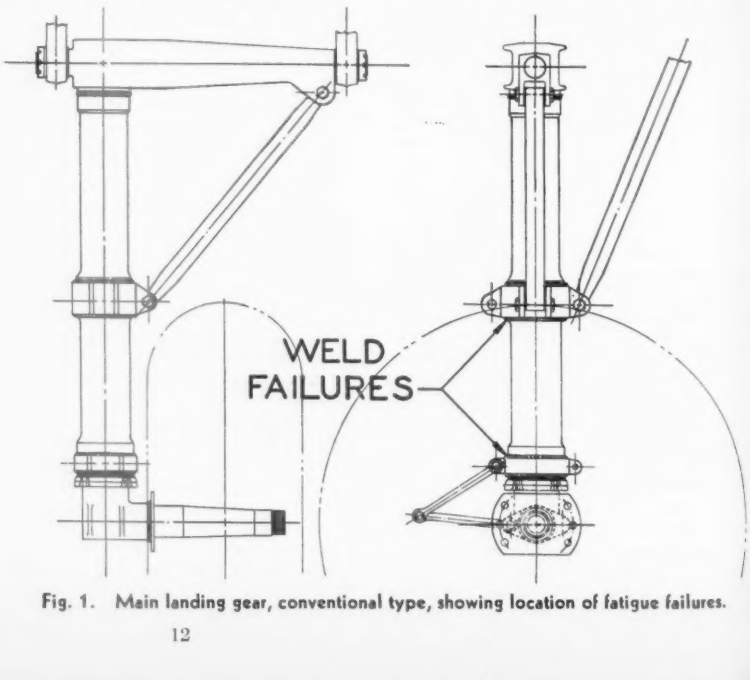

Fig. 1. Main landing gear, conventional type, showing location of fatigue failures.

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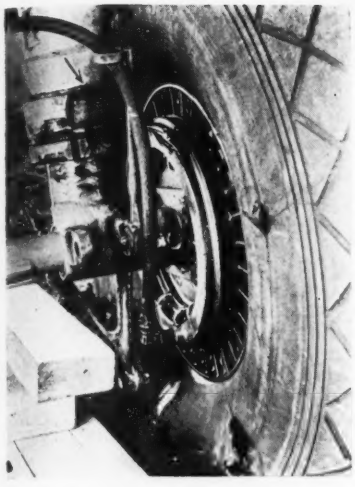

Fig. 2. Failed main landing gear of Fig. 1, showing torque lug fitting torn off.

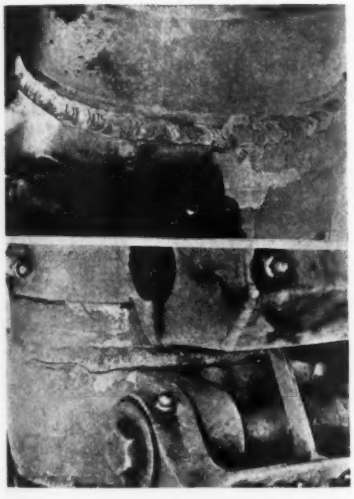

Fig. 3. Cracked welds on torque lug fitting on main gear of Fig. 1.

was torn completely away, permitting the strut inner cylinder to rotate in the outer cylinder, thus allowing the wheel to swing around into a lateral plane. This failure is illustrated in Fig. 2. Immediately upon the occurrence of this failure, a check was made of all ships on the field at which this failure occurred and about 25 cracked welds were found. The severity of crack varied from a minute, hardly discernible crack to one that extended approximately 180° around the cylinder barrel. Typical examples of the more severe types of cracks are shown in Fig. 3.

The Chief Engineer of the Landing Gear Department of Bendix immediately visited the field at which these failures occurred, and his findings were as follows. The field was smooth, and landings were normal; the airplanes were being flown not over 10 per cent above the design gross weight; all landings were made tail high, and cracks had appeared at from 40 to 400 hours flying time, averaging three landings per hour; some gears with more than 400 hours showed no cracks. The location of the cracks with regard to right- or left-hand gears showed no predominance of either side, but cracks usually appeared first on the torque scissors lug weld on the outboard side—i.e., the side next to the wheel—the torque scissors being mounted on the front of the struts. It was notable that most of these failures occurred at this one field, at which the airplane was being landed tail high. A few cases of failure were reported from other fields, but very few from any one field.

A laboratory investigation was started immediately, even before the above information was obtained, to determine (1) the actual strength of the gear and (2) whether any evidence of defective workmanship could be found. This latter point was thought to be of immediate importance, of course, since the first reports of military personnel and the airplane manufacturer were to the effect that the cause of the failures was defective welding. A thorough investigation by X-ray, Magnaflux, microscopic examination, hardness surveys of cross sections, and chemical analysis of weld deposits on both failed struts returned from service and new struts off the production line failed to reveal any evidence of defective material or workmanship.

Static tests of two complete strut assemblies were conducted, in which a drag load was applied to the axle at the wheel centerline. In the first test of a new strut, a torque of 156 per cent of the design ultimate load torque was applied without failure of any sort. The second assembly tested was one returned from service which had a crack 180° long in the weld. First, the pair of lugs which had not been used in service were loaded. (It should be noted that this fitting carries two sets of torque scissors lugs to make the assembly usable as either right or left hand; only one set of lugs was used in service.) At a load of 161 per cent of the design ultimate, a crack approximately 1 in. long appeared suddenly in the weld. After this test, the other pair of lugs, containing 180° of crack, was loaded and withstood a load of 167 per cent of design ultimate. The original crack opened wider, but no rupture occurred.

Following these tests, it was decided that the cause of the service failures must be repeated applications of heavy loads. It was therefore determined to conduct repeated load tests of the gear.

Fatigue Test Equipment

Because of the urgency of obtaining a solution immediately, it was decided to utilize available equipment. Consequently, a 50-ton mechanical press, with a $6^1/_4$-in. travel ram operating at 30 cycles per min., was rigged up with a walking beam carrying a ram to apply drag load to the axle of the strut assembly, which was supported from I-beams on which the press was resting. Fig. 4 shows the installation as first arranged. For some subsequent tests, the rig was modified as shown in Fig. 5. In this figure, A is the ram, fastened to walking beam D, and applying the load to the tube C, slipped over the strut axle.

The load is calibrated by placing the hydraulic jack ram B in the rig in place of the rigid ram A. Load is applied by pump F, and gage E is used for reading the load. When the required load is reached in jack ram B, the deflection at pointer G is measured. Ram A is then replaced in the rig and is adjusted to produce the same deflection at G as above. A treated surface (not shown) is provided on which pointer at G marks, and records are made at intervals throughout the test to check the deflection.

In early tests it was thought probable that the load required to produce a given deflection at the load point might drop off, especially so after visible cracks appear. Consequently, in the earlier tests frequent recalibrations of load were made to determine whether this loss in load was occurring. The surprising fact was established that no detectable change in deflection occurred, even after considerable cracks were evident. It might be pointed out that an indicator was rigged to read the deflection to 0.001 in., but this was found unnecessary and usually a scale calibrated in 64th's was used. Usual magnitude of deflection is of the order of 1 to 2 in. An example of the deflections encountered in the tests of torque fitting welds described above is shown in Fig. 6, which is a double exposure, one exposure being made with no load and the other with limit torque load on the strut.

This machine proved satisfactory for its intended purpose and has been used, with some modifications, continuously since it was built. However, as various

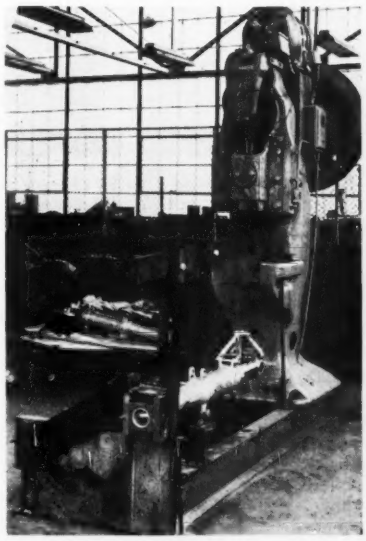

Fig. 4. Mechanical fatigue testing machine, general view.

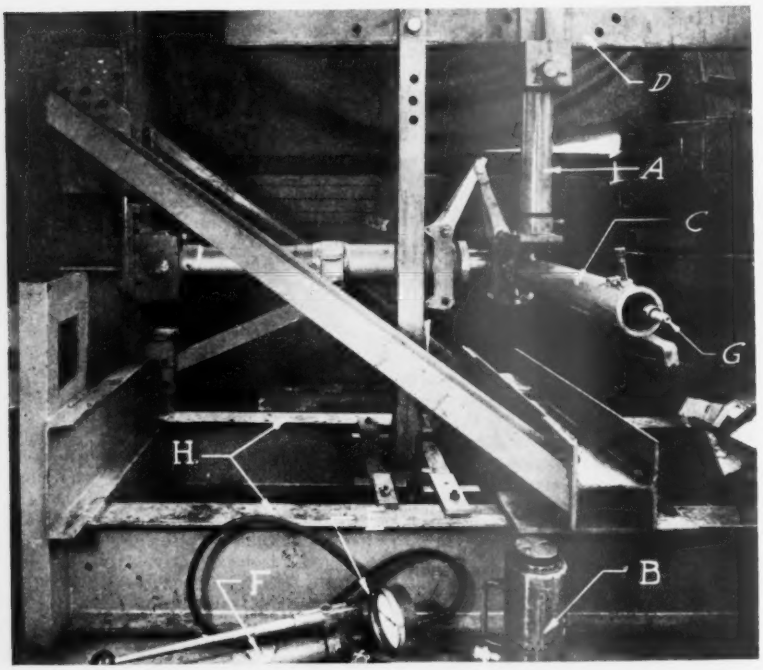

Fig. 5. Close-up of fatigue testing machine, showing method of calibrating load.

Fig. 6. Double exposure view of lower end of main gear of Fig. 1 in loaded and unloaded positions in fatigue machine. Note severe deflections.

fatigue problems arose, it became evident that a more flexible machine and one of larger capacity was needed. Design of such a machine was therefore undertaken.

The design requirements established for this new machine were as follows: maximum load, 100,000 lbs.; maximum stroke, 6 in.; rate of cycling at maximum load and stroke, 20 cycles per min. It was further desired that the machine should be as flexible as possible—e.g., that the ram should be adapted to mounting at any angle, applying load either in tension or compression, or both. Also, it was desired to be able to control the cycle by either the load applied or the stroke. A hydraulically actuated machine was decided upon as being best adapted to the requirements.

Two 2,000 lbs. per sq.in., 18 gal. per min. two-stage vane-type pumps, driven at 1,200 r.p.m. by 20-hp. motors, provide the power. Two smaller units were decided upon in place of one larger unit in order to provide greater flexibility, especially inasmuch as this would permit using one of the units in an adjacent cold-test laboratory at any time except when extremely heavy loads were to be applied. These pumps feed oil to the double-acting load cylinder through a four-way solenoid operated valve. The solenoid is controlled either by a pressure switch in the line adjacent to the load switch or by a limit switch controlling the ram travel. Three different sizes of load cylinders are used, depending upon the load to be applied. One end of the load cylinder is universally mounted, and the other is pin-connected to the test specimen. The jig for mounting the test specimens is a cube, 8 ft. on a side, made of H- and I-beams, predrilled for flexibility of arrangement.

Early in the investigations it became apparent that a means of detecting the occurrence of fine cracks was desirable, since the usual history of a specimen involved the occurrence of an extremely small crack, which gradually grew and spread until complete failure finally took place. Several means, including the use of Magnaflux powder and paste, with residual magnetism in the specimen, were tried. It was finally concluded that the best means was by visual observation, with a magnifying glass, and that a magnification of approximately ten times was best. As a check on how early cracks were detected, test of one specimen was stopped as soon as a crack was observed. Thes pecimen was sectioned through the crack, and under a microscope the crack was observed to have a maximum depth of 0.003 in. This is shown in Fig. 7 and is thought to be typical of the size of cracks when first detected. However, the exact size is thought to be, in most cases, of only relative significance, since a specimen thus cracked would usually last for a considerable time before the

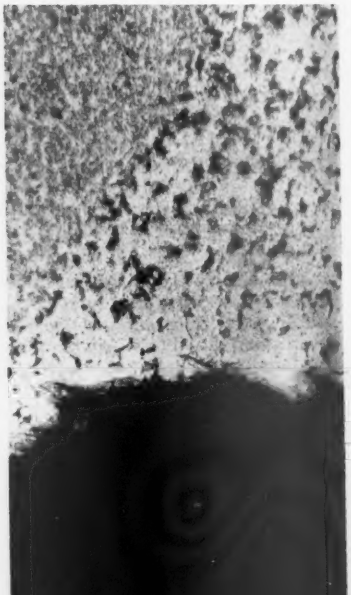

Fig. 7. Fatigue crack immediately after discovery (magnified 300 times).

Fig. 8. Fatigue crack in main gear torque fitting after 2,600 cylinders of limit load.

crack grew to sufficient size to be visible to the naked eye, even when working under load cycling.

The statements above warrant discussion of what constitutes failure. The usual fatigue test assumes that failure consists in actual rupture of the specimen; this is satisfactory in a search for the endurance limit of a material but hardly seems acceptable in aircraft practice, where rupture of a primary structural member may be disastrous. Some definition of failure is required. It appears to the author that it might be desirable to establish for fatigue loading some criteria, similar to that established for static loading, in which no permanent set is permitted below the limit load and no failure below the ultimate load. Similarly, in fatigue, there might be established a "limit" number of cycles of loading below which no visible crack is permitted and an "ultimate" number below which no failure is permitted.

Correlation of Service and Laboratory Results

Referring back to the torque fitting failures described above, a series of repeated load tests was made in the mechanical rig described above. In these tests a drag load was applied to the axle at the wheel centerline, the load being of such a magnitude as to produce limit load torque about the oleo centerline. Both extended and static positions of the gear were investigated. These tests indicated the appearance of the first minute crack at from 100 to 500 applications of load; this first crack usually grew rather slowly, so that complete failure of the part occurred at from 4,000 to 6,000 cycles. Fig. 8 shows a laboratory crack after 2,600 cycles of load, strut extended. Comparison of this with Fig. 3 indicates that the laboratory failures closely reproduced service failures so far as location and nature of the cracks are concerned.

To make a further check to determine whether omission of the vertical component of load in the fatigue test and/or the rate of application of load were affecting the results, a series of repeated drop tests of the gear was made. These drops were made in such a way as to produce limit load torque about the oleo axis. After the 127th drop, a minute crack was discovered in the same location as on fatigue test and service specimens. On the 169th drop, the wheel and tire failed, and the tests were discontinued. The correlation between number of cycles to appearance and rate of growth of the first crack in drop tests and fatigue tests was thought to be excellent.

As a further check on the design, fatigue tests were conducted on two specimens of a landing gear using the identical torque scissors, pins, bolts, etc., as the gear in question. Further, the design torque on this second gear is within one-half of 1 per cent of the design torque of the subject gear. However, this second gear carries torque lugs forged integrally with the cylinder barrel so that no weld is involved. In these tests the first cracks appeared at 1,395 and 1,100 cycles; complete destruction, at 2,480 and 2,640 cycles, respectively. Failure of one of these is shown in Fig. 9. These tests indicate that the forged design has a lower life to failure than the welded design. This forged design is for a combat airplane that has been produced in large quantities; not a single case of service trouble of any sort has been reported with this design. It, therefore, appears that while the integral type forging shows shorter fatigue life under test than the welded type, nevertheless it is entirely satisfactory in service. Inasmuch as the design criteria were the same, it appears that the method of design was not unsound.

Various means of strengthening the gear were tried, such as using a spacer between the lugs to distribute the lateral bending load, use of alloy welding rod instead of the carbon steel rod originally employed, and use of button welds through the fitting strap to distribute the load more uniformly. None of these methods provided a sufficient increase in life to warrant their use as a means of providing adequate service life. Consequently, the stratagem of using two sets of torque scissors per strut was resorted to. This was possible on struts already in service, as the strut was originally provided with two sets of lugs in order to make it interchangeable for either left- or right-hand gears. With two sets of scissors, a torsional life of approximately 59,000 cycles was obtained; at this life a rather severe crack existed, but the gear was still carrying the full load. (The first minute crack was observed at 28,116 cycles.) Thus a life of approximately ten times the original life was obtained by using two pairs of scissors. This means of strengthening was used in service, and no further difficulties have been reported.

It might be pointed out here that the life of other portions of the torque members, as determined in these tests, was in line with the welded fitting: use of alloy welding rod and rosette welds in combination resulted in failure of the cylinder barrel, adjacent to the weld at 9,635 cycles to failure; life of forged lugs on the inner cylinder was two to three times that of the outer cylinder fitting; life of torque arms was of the order of 50,000 cycles; torque arm shear sleeves had a life of the order of 8,000 cycles; on a special fitting with heavier strap and cylinder barrel, the lug failed in tear-out at 8,129 cycles. Thus the fatigue life of the various portions of the torque-transmitting members is fairly uniform.

Fig. 10 is an attempt to plot an S-N curve for the torque fitting failures. The ordinate is the stress, in per cent of static failing strength, and the abcissa is number of cycles to failure. This curve is presented with an apology for the paucity of data, but it is given here to illustrate the fact that at limit loads the stresses are above the familiar "knee" of the S-N curve and, consequently, in the region of relatively short life as compared with the endurance limit. This point will be emphasized later.

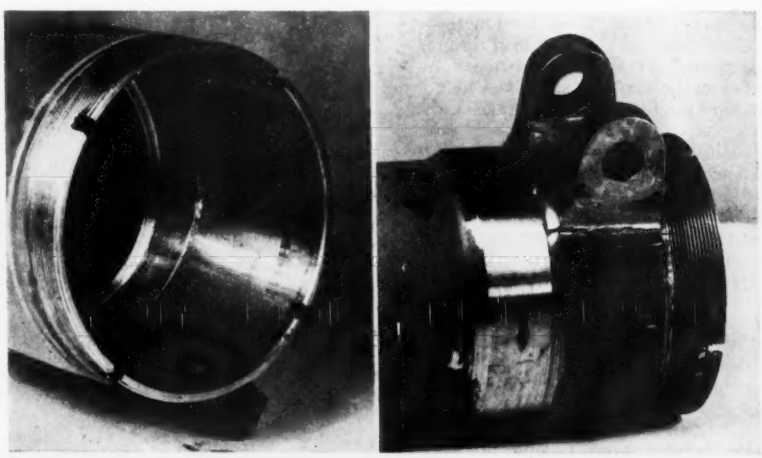

Fig. 9. Fatigue failure of forged main gear torque fitting, after 2,480 cycles of limit load.

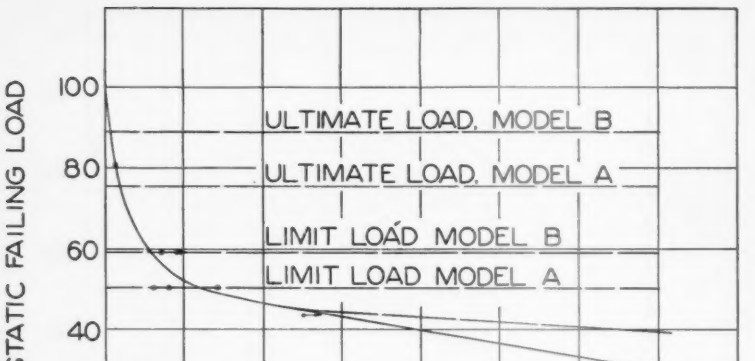

Fig. 10. S-N curve for torque fitting failures on gear of Fig. 1.

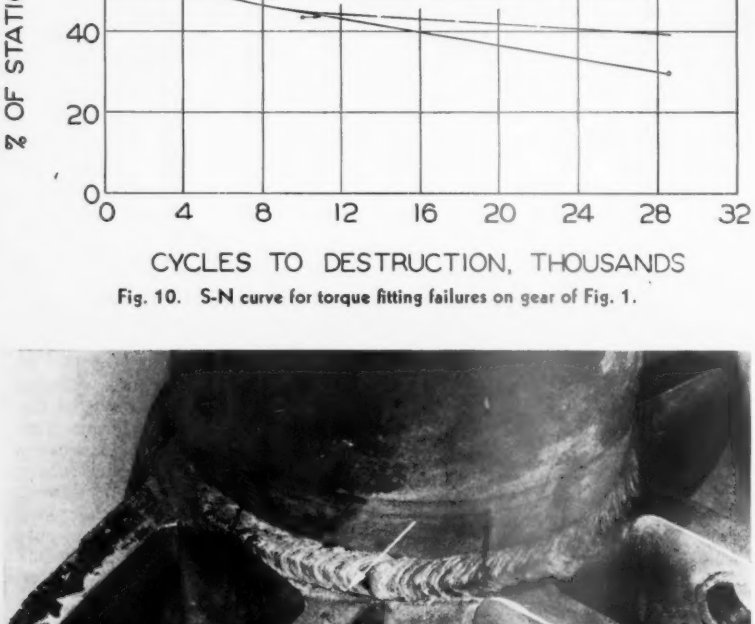

Fig. 11. Service crack in weld of brace strut fitting of Fig. 1.

As stated above, these torsion tests were conducted at the limit load torque. Subsequently, taxiing tests were conducted on the airplane, and it was found that hard application of the brakes during a fast taxi, on rough ground, resulted in a torsion in the oleo strut of 105.5 per cent of design limit load torque.

A second example of service failures occurred in this same landing gear, this time at the drag brace strut fitting on the outer cylinder of the shock strut. A typical example of such a service failure is shown in Fig. 11. Again a static test was conducted, and failure of the fitting occurred at 232 per cent of the design ultimate load, but not until after failure of the supporting drag brace at 211 per cent of the design ultimate. Again it was concluded that the service failures were fatigue failures, and a series of repeated load tests was undertaken.

Fig. 12. Fatigue specimen under ultimate design load, after 5,000 cycles of this load (crack lies between pencil points).

In these tests a drag load was applied to the axle so as to produce critical limit tension load in the drag brace. Only the tension load was used, since service cracks were all of such nature and location as to indicate that the failures were due to tension load. In two tests run at this load, the first minute crack was discovered at 5,300 and 10,600 cycles, respectively. These two tests were continued to 20,000 and 15,000 cycles, respectively, with very slow rate of growth of the cracks. It was decided to increase the load because the time required to obtain the desired results would have been excessive if tests were continued at limit load. Also, service cracks were noted at 150 to 175 landings, and it was thought that the number of cycles per landing, of heavy load, must be very low; it would, therefore, be desirable to reproduce service cracks at less than 1,000 cycles.

Consequently, the load was increased to the ultimate design load for one test. In this test the first crack was noted at 690 cycles. At 5,000 cycles the crack was visible to the naked eye for a length of 1 in. At this point a reinforcing bracket was applied to the cylinder to obtain information on the advisability of using such a bracket to repair struts cracked in service. After 3,500 addi-

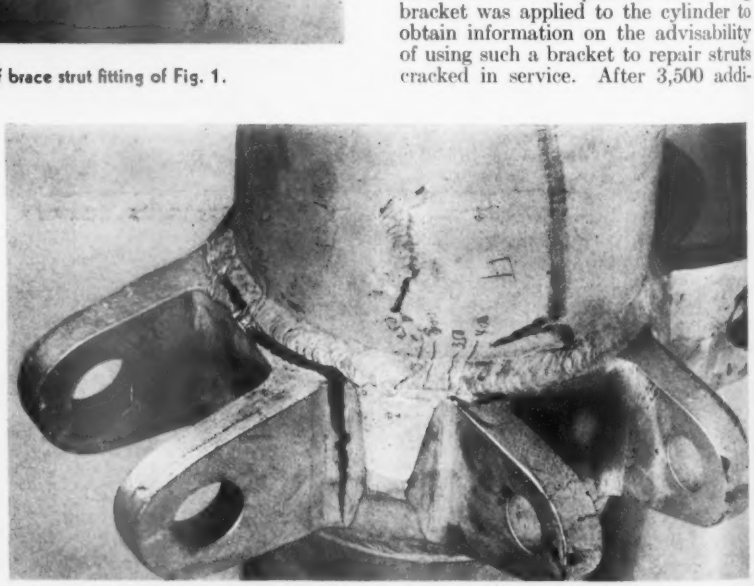

Fig. 13. Fatigue failure after 778 cycles of 150 per cent of ultimate load.

tional cycles, no growth of crack was noted.

At this time two cylinders were obtained which had failed in service. A comparison of the cracks in these cylinders with those produced in the laboratory tests above indicated that the appearance of the cracks was not exactly similar, and, also, as noted above, it was thought that reproduction of service cracks was requiring too many cycles in the tests. It was decided to increase the test load to 150 per cent of ultimate design. The earliest appearance of a minute crack in three tests at this load was 97 cycles, and the total life in these tests was from 778 to 978 cycles. The cracks produced in these tests exactly reproduced service cracks at approximately 600 cycles. Fig. 12 shows a specimen under ultimate design load after 5,000 cycles of this load. Fig. 13 shows a specimen after complete failure at 778 cycles of 150 per cent of ultimate load. It was then decided to try to obtain 5,000 cycles of 150 per cent of ultimate load on a revised design.

The addition of the reinforcing bracket mentioned above was found to provide a total life of 10,000 cycles of 150 per cent ultimate load on a new cylinder and an added life in excess of 5,000 cycles on a cylinder with a 3-in. crack that had developed in service. These brackets were therefore applied to cylinders in service, and no additional troubles have been reported. For further production, the brace fitting was reinforced, and tests at 150 per cent ultimate load produced a fatigue life of approximately 9,000 cycles. This was considerably above the arbitrarily specified life of 5,000 cycles, and no service troubles have been reported with this fitting.

Fig. 14 is an S-N plot of the data obtained in these tests; the coordinates are the same as those used in Fig. 10 and the same apology is made for the paucity of data. However, the curve is presented for what it is worth to indicate the extremely low life in the stress range in which these parts are operating.

In subsequent static tests of this main landing gear mounted in the airplane, it was found that the deflection characteristics were such that the load in the drag brace strut was 155 per cent of the calculated load. This would reduce the static failing load of 232 per cent of design ultimate to 150 per cent of actual ultimate. It would also indicate that the fatigue tests conducted at "150 per cent of design ultimate load" were, instead, at 97 per cent of ultimate load.

In order to obtain additional information on the stress distribution in these struts, a Stresscoat test was conducted, under static loading. The pattern obtained in the vicinity of the brace strut fitting is shown in Fig. 15. Attention is called to the concentration of lines in the vicinity in which fatigue failures start. The numbers on the specimen are proportional to the load applied; the proportions are such that 1,000 on the specimen corresponds with a load in the brace strut of 7.65 per cent of the static failing load or 20.75 per cent of the design ultimate load. Fig. 16 is a general

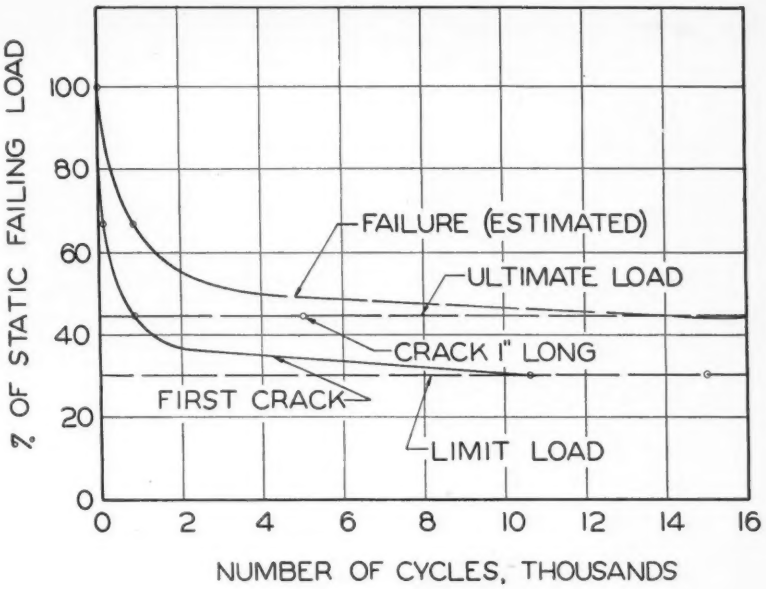

Fig. 14. S-N curve for brace strut fitting failures.

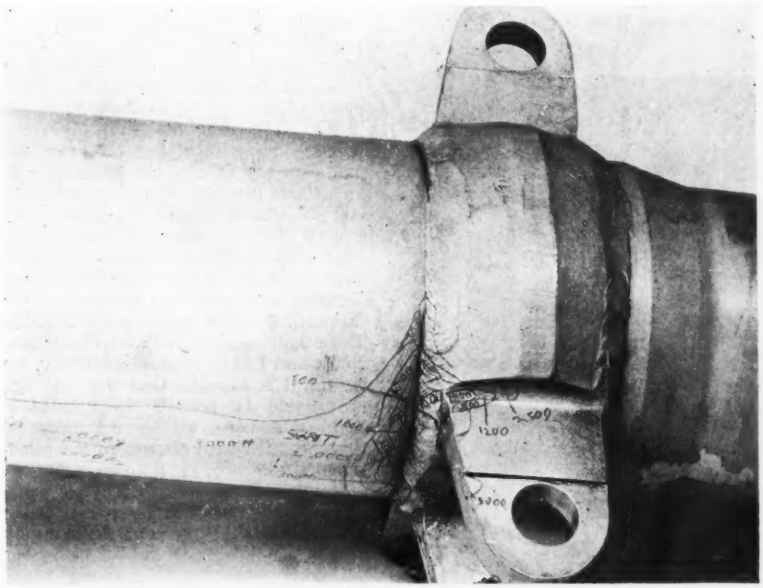

Fig. 15. Stresscoat pattern in vicinity of brace strut fitting of main gear of Fig. 1, static loading.

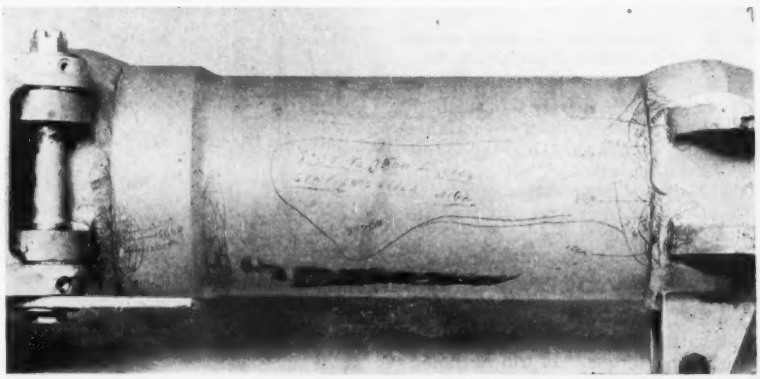

Fig. 16. Stresscoat pattern between torque lug fitting and brace strut fitting of main gear of Fig. 1, static loading.

Fig. 17. Dynamic load Stresscoat pattern at torque fitting of gear of Fig. 1.

Fig. 18. Dynamic load Stresscoat pattern at brace strut fitting of gear of Fig. 1.

view of the cylinder barrel, showing both the pattern in the vicinity of the brace strut fitting (at the right) and the torque scissors fitting (at the left). Again, 1,000 on the specimen corresponds with a torque of 7.82 per cent of the static failing torque of the scissors fitting. Also, a drop test was conducted of a Stresscoated specimen. The dynamic Stresscoat patterns are shown in Figs. 17 and 18; the maximum applied torque in this test was 10.6 per cent of static failing torque. It will be noted that these Stresscoat specimens show good correlation with the fatigue specimens indicating the regions of failure.

Some additional light is thrown on fatigue stresses by a series of tests on another landing gear. These tests were run for salvage purposes to determine whether thin-walled torque fitting lugs were acceptable. In these tests, the first step was to run a Stresscoat test to determine locations and directions of maximum tension stresses. Following this, a test was run with electric strain gages located at the points of maximum stress. Finally, fatigue tests were conducted. In the fatigue tests, failure occurred in a $^1/_{16}$-in. radius at the bottom of the milled cut on the face of the torque lug fitting, as shown in Fig. 19. (The rectangular cutouts in the cylinder were made after completion of the tests.) This was the location of maximum stress as shown by the Stresscoat and strain gage tests. The strain gages indicated a stress at this point of 106,000 lbs. per sq.in. at limit load; fatigue tests yielded a life to failure of 9,000 and 14,000 cycles in the two specimens tested.

Several fatigue tests of axles have been conducted. One of these was the axle for the main landing gear of a Navy fighter of approximately 11,000 lbs. gross weight. In these tests critical limit shear and bending loads were applied to the section at the face of the brake flange. First minute cracks at this point appeared at from 100 to 1,000 cycles of loading, with failures as shown in Fig. 20 at from 2,320 to 3,530 cycles.

A second series of tests of axles was made on the axle of the main gear of an attack bomber, approximately 22,000 lbs. gross weight, equipped with tricycle landing gear. Again critical limit load shear and bending moment were applied. In four test runs, failure occurred at a radius in the corner of the supporting socket, as shown in Fig. 21. These failures occurred at 1,715, 2,284, 2,564, and 1,111 cycles, respectively, although it is thought that this last figure should be rejected because of a slight difference in method of support of this specimen with respect to the other three. Because of the nature of the support, it was impossible to observe the advance of failure during the test in order to determine the life until appearance

Fig. 19. Fatigue failure of torque lug fitting, main gear, conventional type, after 9,000 cycles of limit load.

of the first crack. Neither of these axles has shown any service troubles; the latter has been in large quantity production for about 4 years.

Designing for Fatigue

One other example will be given—this time an example of designing for fatigue.

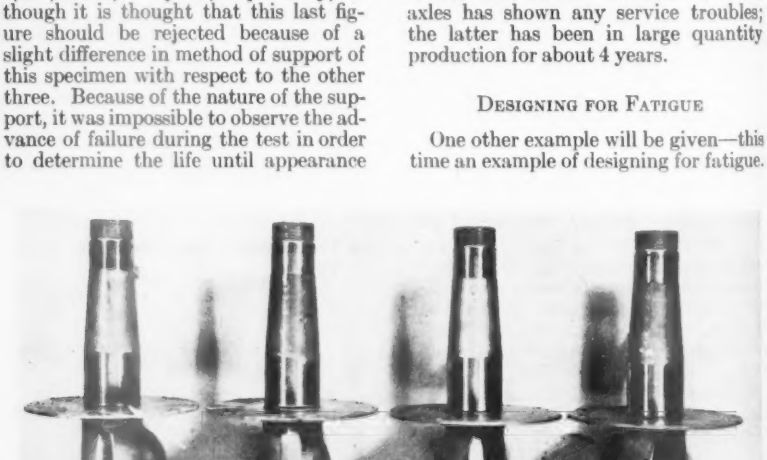

Fig. 20. Axle fatigue failures, main gear, conventional type; figures denote number of cycles of limit load.

This landing gear was designed for application to an airplane that was developed from that on which the torque fitting failures first described occurred. It was agreed by representatives of the customer, the airplane manufacturer, and Bendix Products that the torque-transmitting members of this landing gear would be designed for a fatigue life, under limit loads, of 49,000 cycles. Accordingly, Bendix proceeded with the design and manufacture of the landing-gear shock struts for the experimental airplane with one extra strut for fatigue test.

This test strut was run in the mechanical fatigue machine, and at 40,000 cycles one torque arm failed in tension tear-out, as shown in Fig. 22. The test was continued by reversing the torque arms, and the outer cylinder failed, at a relief radius at the end of a thread, at 68,000 cycles, as shown in Fig. 23. No failures occurred in the cylinder torque fittings, and so the torque scissors were strengthened somewhat and the strut was put into production.

A later occurrence brought out some interesting information on detail design. The scissors for the above gear were designed for use of needle bearings in the large end; however, it was impossible to obtain the bearings in time for the above tests. Therefore, bronze bushings, of identical external dimensions with the needle bearings, were substituted in the test. After the gear was put into production, it was decided to make a fatigue test of a production strut. In this test, a torque arm failure occurred at 15,700 cycles, as shown in Fig. 24. An immediate investigation was made to determine the cause of the discrepancy between this and the original test life of 40,000 cycles. It was found that with no change other than the bearings, the following average lives were obtained: needle bearings, 15,675 cycles; bronze bushings, 46,800 cycles; steel bushings, 58,280 cycles. It was concluded that this variation is due to variation in bending stresses across the section of failure. The needle bearings, having thin races, offered relatively small resistance to deflection and allowed bending across a section normal to the plane of the load. The solid bushings, of course, provided much greater resistance to ovalization, and obviously the steel is superior to the bronze in this respect. In this connection it was noted that the failures started at the threads in the lubricator holes, at the inner end, Fig. 24. The unit strains on the faces of the lubricator bosses are shown in Fig. 25 for the three different types of bearing; these curves were obtained by the use of electric strain gages. Note that the strain in all cases is compression, verifying the above assumption of bending across this section.

Discussion and Conclusions

It is realized, of course, that the data given above are scattered, scanty, and inconclusive. However, it is thought to give sufficient evidence of certain design factors to warrant much more extensive

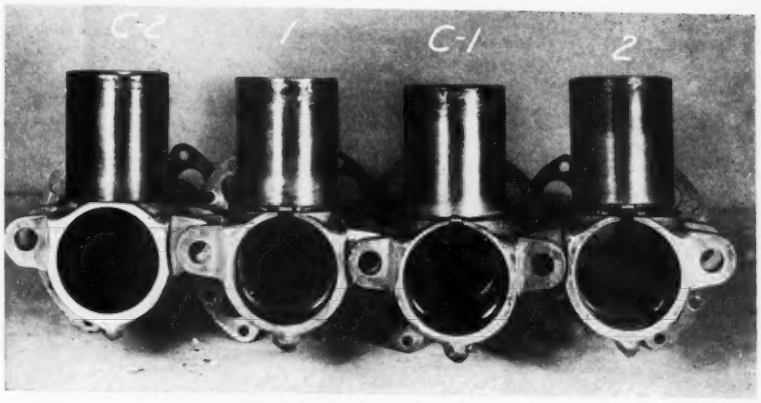

Fig. 21. Axle socket fatigue failures, main gear of tricycle type gear; figures denote number of cycles of limit load.

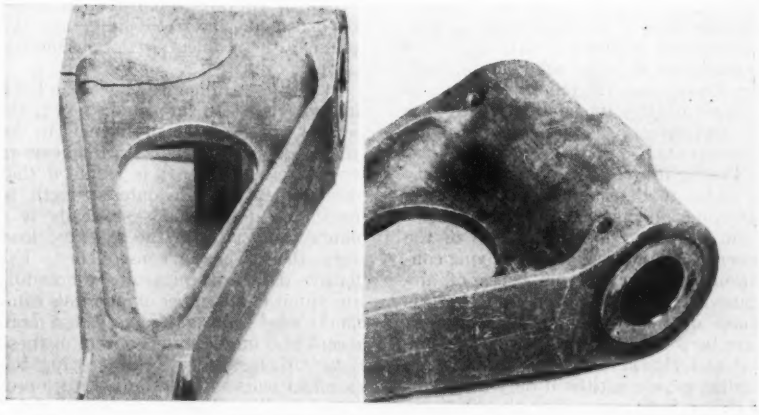

Fig. 22. Torque scissors fatigue failure, main gear, conventional type after 40,000 cycles of limit load.

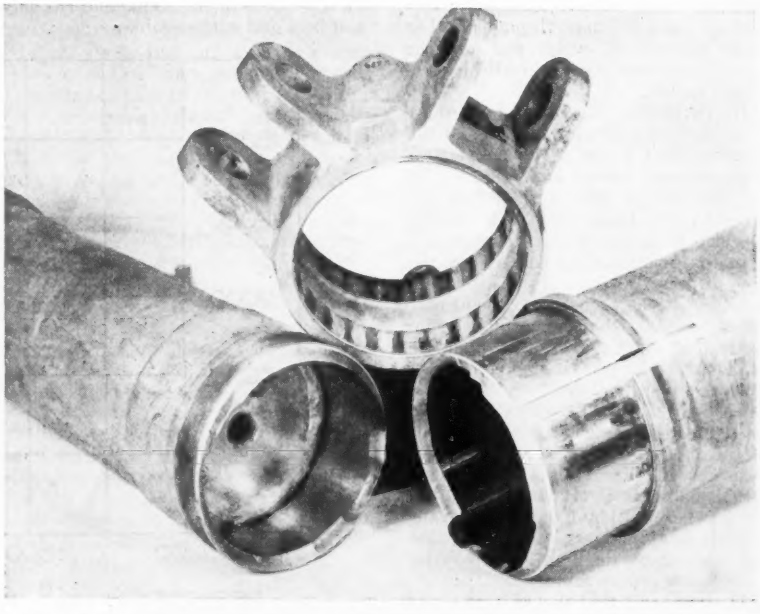

Fig. 23. Outer cylinder fatigue failure, main gear, conventional type, after 68,000 cycles of limit load.

Fig. 24. Torque scissors of Fig. 22 after 15,700 cycles of limit load with needle bearings.

investigations. It is further thought that the lines of attack of these investigations are indicated: (1) flight investigations of actual take-off and landing loads, and (2) laboratory investigations of the repeated-load strength of landing-gear assemblies and their components.

The flight investigations are necessary in order to determine the magnitude, direction, and frequency both of maximum loads developed and also of the lesser loads under all types of flying conditions and for various types of airplanes. A start has been made on this phase of the investigation, and data have been published by Bergen of Martin[1] and Howland of Lockheed.[2] The landing gear constituted only a portion of the problem covered by these two investigators, and the data published on the landing gear are meager. However, it is extremely interesting in that these data show rather high drag and side loads that vary from positive to negative values and which fluctuate through a rather large number of cycles per landing; considerable variation in vertical loads is also shown.

In particular, Bergen's data show drag loads considerably in excess of the specified limit values, while the vertical loads did not exceed limit values. In the only flight data available in the present paper, loads closely approaching specified limit values were measured.

In the investigations covered by the present paper, no data of this kind were available at the time, and consequently it was necessary to decide arbitrarily on the load at which a given test should be conducted. It was thought that, in general, the critical limit load from the stress analysis should be used, and this was done in all cases as a starting point. In the original torsion tests, later flight tests showed close correlation between actual loads and limit loads; in other cases (where no flight data were available) it was necessary to increase the test loads above the limit loads in order to duplicate service failures.

Another point that should be noted is that all these tests were conducted at constant load; the Martin and Lockheed data cited above indicate many cycles of varying amplitude, as would be expected. It is thought that this phase of the problem needs considerable investigation.

With the loadings to which the landing gear is to be subjected known, the second phase of the problem is to develop adequate strength in the gears to meet these loads. It is assumed that development of adequate strength to resist the design loads statically is a minor problem, and the repeated load strength is of major consequence. Extensive data exist regarding the endurance limit of a number of materials commonly used in aircraft, one of the more recent and outstanding sources of these data with regard to aircraft being the excellent work of Battelle Institute prepared for the Bureau of Aeronautics.[3] This work is particularly valuable in that it contains information regarding the strength of various subassemblies, rather than just test bars. However, most of the available data concerns only test bars and not assemblies.

Further, and probably more serious, is the fact that the great emphasis in most researches done to date has been on the determination of the endurance limit of the particular material being investigated, so that little data are available on the low cycle, high stress portion of the curve. It is hoped, as stated above, that the curves given in Figs. 10 and 14, together with the service data regarding these gears, illustrate the contention that extensive investigation of very low cycle, high stress fatigue loading is warranted. It will, of course, be obvious that in the usual designs the stresses at limit loads will be considerably above the endurance limit, since this latter is roughly half[4] the ultimate strength, in steels. (This ratio of endurance limit under reversed bending to ultimate tensile strength has been called "endurance ratio" by D. J. McAdam, Jr.[4])

Almen, of General Motors, in an excellent paper[5] on stress determination and fatigue presents Table 1 of "life requirements at maximum stress of a few typical machine elements as determined by service experience."

TABLE 1.
Life Requirements at Maximum Stress in Cycles

Automobile rear-axle gears	100,000
Automobile transmission low gear	100,000
Automobile chassis springs	100,000
Automobile transmission second gear	300,000
Truck rear axle	500,000
Bus rear axle	1,000,000

The surprising thing about this table is the relatively small number of cycles required. In the light of these data, for automotive parts, it appears that perhaps the low numbers of cycles reported in the present paper are not too

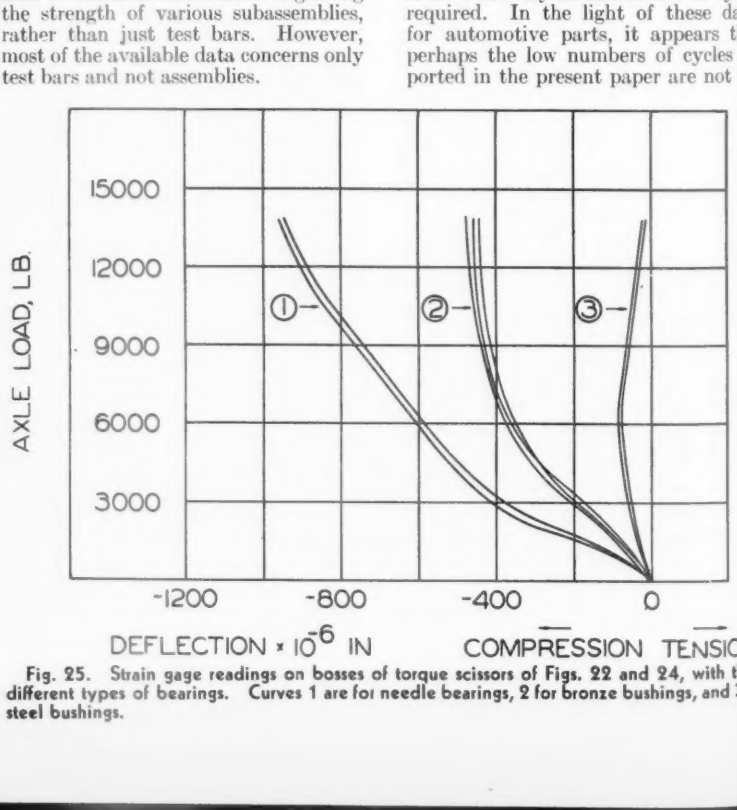

Fig. 25. Strain gage readings on bosses of torque scissors of Figs. 22 and 24, with three different types of bearings. Curves 1 are for needle bearings, 2 for bronze bushings, and 3 for steel bushings.

far out of line with what may be expected as requirements for aircraft. For example, an airplane wheel will rotate only 1 to 2 per cent as many revolutions in 1,000 hours of flying time as an automobile wheel will rotate in 100,000 miles of driving; further, the number of cycles of maximum, or near maximum, load is unknown, and it is the need for this information which is here emphasized. It is interesting to note that Boyvey, of Consolidated Vultee Aircraft Corporation, concludes[6] that "a figure of 5,400 applied load applications for the landing gear parts of the trainer airplane" is adequate to ensure satisfactory service life; he refers to this figure as the "fatigue limit." He further states that "this figure has been arbitrarily increased to 6,000 for use as a design criteria. If the airplane under consideration were a commercial transport, our landing gear criteria would be reduced . . . because of the skill of the airplane pilots in landing."

In the determination of both the required fatigue life for adequate service life and also the actual fatigue life of given specimens, the effects of cycling with varying values of load need to be determined. Most of the available data on this subject, all on simple specimens, has been obtained in connection with the effects of overstressing and understressing with respect to the endurance limit of the material.[3,4] As pointed out above, this region is not of much importance in the present case. Langer[7,8] has presented a method of predicting life under varying loads, but his method makes necessary rather extensive test data.

In summary then, this paper has pointed out that the limit loads on landing gears are, on certain airplanes on which data are available, frequently approached or exceeded. It has also been shown that landing gears having an actual static failing strength, by test, considerably in excess of the design ultimate loads will withstand only a small number (a few thousand) of applications of the limit load. It has further been shown that some landing gears, with high static strength, have only a relatively short service life, while others, with no better fatigue test life, are entirely satisfactory in service. It is, therefore, concluded that, in order to ensure adequate service life of landing gears, there is need for the establishment of criteria for the repeated load strength of landing gears, these criteria to be based upon an extensive survey of service life and a correlation of the results of this survey with laboratory tests.

References

[1] Bergen, W. B., *Experimental Investigation in Aircraft Dynamics*, Journal of the Aeronautical Sciences, Vol. 10, No. 8, p. 233, October, 1943.

[2] Howland, W. L., *Structural Flight Research*, paper presented at War Engineering Annual Meeting, SAE, Detroit, January 10–14, 1944.

[3] Battelle Memorial Institute, *Prevention of the Failure of Metals under Repeated Stress;* John Wiley & Sons, Inc., New York, 1941.

[4] Landau, D., *Fatigue of Metals;* The Nitralloy Corporation, New York, 1942.

[5] Almen, J. O., *Facts and Fallacies of Stress Determination*, SAE Journal, Vol. 50, No. 2, page 52, February, 1942.

[6] Boyvey, H. O., *Fatigue—The Forgotten Member of the Design Family*, Aero Digest, Vol. 44, No. 1, page 74, January 1, 1944.

[7] Langer, B. F., *Fatigue Failure from Stress Cycles of Varying Amplitude*, Trans. A.S.M.E., Vol. 59, pp. A160–A162, 1937.

[8] Discussion of reference 7, above, Trans. A.S.M.E., Vol. 60, pp. A180–A182, 1938.

Relation of Air-Line Operations to Transport Design

(*Continued from page 11*)

as a delay in the record of the air line but it is 10 to 20 min. the enplaning passenger must add to his travel time.

Dispatching

The problem of dispatching aircraft involves the maintenance of satisfactory records to show compliance with Civil Air Regulations as well as with company regulations, the determination of permissible gross weight, the selection of alternate airports, determination of fuel requirements, the calculation of mail, express, passengers, and baggage on and off, and the proper location of center of gravity to assure satisfactory balance. Dispatching is the behind-the-scenes planning and paper work that permits the air line to operate safely and economically and is often the cause of holding the flight on the ground after all work on the airplane has apparently been completed. The operational problems of the air carrier must be carefully studied in order that the airplane design will permit the operator to simplify dispatching procedures and at the same time comply in every respect with government and company regulations.

Past Civil Air Regulations were relatively simple when compared with the new requirements contained in C.A.R., parts 04 and 61. The problem of dispatching aircraft will be increased manyfold and it is almost a certainty that delays due to dispatching will become of major importance. It is even conceivable that in taking-off from an airport at low altitude en route to an airport at higher altitude there may be three or more allowable take-off gross weights depending on runway length, wind direction, and wind velocity at the point of take-off, as well as three or more allowable take-off gross weights based on runway and weather conditions at the airport of destination; six or more possible take-off gross weights without even considering that conditions at the alternate airport might introduce further complications. The dispatcher will quite literally be at the mercy of the wind, for, if the wind shifts or increases in velocity after he has completed his forms, he may have to start his calculations all over again and pull off part of the pay load already aboard the airplane.

If the transport airplane designer is to design reliability in scheduled operation into his product, it is clear that he must determine the causes of delays on the ground and find the relation of these factors to his design. This objective can be achieved only by careful analysis of air-line operational data.

Conclusions

Now that considerable progress has been made in the solution of the basic problems of flight, the transport design engineer is enabled to direct increasing attention toward adapting the airplane to serve accurately and efficiently the requirements of the operator.

The accomplishment of this end requires four steps:

(1) A thorough understanding and appreciation of the operator's problems.

(2) The accumulation of factual data about the air-line's past and present operations.

(3) The analysis and evaluation of these data so as to provide the foundation upon which present and future design decisions will be based.

(4) The consideration of utilitarian features together with the technical features from the inception of the preliminary design.

This study must be developed to the status of a science. Methods of measuring and interpreting the intangible factors must be evolved. Difficult as these accomplishments may appear, they must be realized if the transport design is to fulfill precisely the operator's needs.

It is suggested that Profit-Earning Capacity is a criterion that may be used to evaluate all of the various utilitarian and technical factors which together constitute that complicated and highly refined vehicle: the Air-Line Transport Airplane.

PRIVATE FLYING

A selective bibliography prepared especially for the Aeronautical Engineering Review by Arthur G. Renstrom, Librarian, Civil Aeronautics Administration

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BIBLIOGRAPHY

GENERAL

1,000 Airplane Owners in the United States by 1950. If not, Why not? by Cyril C. Thompson; *U. S. Air Services*, April, 1939, Vol. 24, No. 4, pp. 14–16, 38.

Aviation's Newcomer—the Eager Customer, by Clinton M. Hester; *Journal of Air Law and Commerce*, January, 1940, Vol. 11, pp. 33–40.

Tomorrow We'll Be Going Places! by H. Curtis; *Successful Farming*, October, 1942, Vol. 40, No. 10, pp. 13, 36, 104.

John Doe's Flying Carpet, by S. C. Frazier; *Aircraft Age*, March, 1943, Vol. 2, No. 2, pp. 20–21, 56, 59.

The Light Plane. Signs Point to a Wider More Utilitarian Future for the Sportsman's Plane of Past Years; *American Exporter*, May, 1943, Vol. 131, No. 5, pp. 14–16.

Report to W. A. M. Burden on Postwar Outlook for Private Flying, by John H. Geisse and Samuel C. Williams, Washington, D.C., Civil Aeronautics Administration, September 30, 1943, 196 pp.

We Need a Simple Plan [for private flying], by Charles I. Stanton; *Air Progress*, September, 1943, Vol. 3, No. 3, pp. 32–33, 69.

20,000 Leagues above the Ground [discussion of personal airplane ownership and use], by Leighton Collins; *Air Facts*, November 1, 1943, Vol. 6, No. 11, pp. 9–21.

Private Flight Up to Now, by William B. Stout and Franklin M. Reck; *In their* Tomorrow We Fly, New York, 1943, pp. 44–52.

The Outlook for Postwar Civilian Flying, by E. J. Kulas; *Automotive and Aviation Industries*, December 15, 1943, Vol. 89, No. 12, pp. 17–19, 98, 100.

Realism is Requisite in Appraisals of Postwar Aviation; Overselling of the Public on What Can Be Accomplished in the Early Post-Armistice Period Represents a Definite Threat to the Industry, by P. J. Frizell; *Aviation*, January, 1944, Vol. 44, No. 1, pp. 118–119, 326, 329–330, 333.

Private Flying's Future; *National Aeronautics*, February, 1944, Vol. 22, No. 2, pp. 12–13, 36.

Vast Private Flying Expansion Foreseen [C.A.A. report "Outlook for Private Flying"], by Clifford Guest; *American Aviation*, February 1, 1944, Vol. 7, No. 17, pp. 15, 36–37.

"Main Street" in the Coming Air Age, by W. T. Piper; *Aero Digest*, February 15, 1944, Vol. 44, No. 4, pp. 88–89.

Down to Earth on Post-War [Personal Plane] **Planning,** by Lee N. Brutus; *Western Flying*, April, 1944, Vol. 24, No. 4, pp. 228, 230, 232.

Aviation is Everybody's Business, by C. I. Stanton; *Aero Digest*, April 1, 1944, Vol. 45, No. 1, pp. 54–55, 118.

CAA Economist Foresees a Million Lightplanes, Helicopters by 1960; *American Aviation*, April 1, 1944, Vol. 7, No. 21, p. 24.

The Outlook for Private Flying, by Lawrence Black; *Western Flying*, May, 1944, Vol. 24, No. 4, pp. 42–43, 98.

Development and Regulation of Civil Aviation [including Private Flying], Report of Transportation and Communication Committee, Chamber of Commerce of the U.S.A., Washington, D.C., May, 1944, pp. 4, 10–11.

On Postwar Airlines and Private Flying, by R. S. Damon; *Air Transport*, May, 1944, Vol. 2, No. 5, pp. 21–25.

500,000 Planes—4,000 Airports; *American Pilot*, May, 1944, Vol. 5, pp. 21, 29.

A Preface to Postwar Planning. Part IV—Private Flying, by George E. Haddaway; *Southern Flight*, May, 1944, Vol. 21, No. 5, pp. 50, 52, 54.

Requisites of the Mass-flight Age, by C. J. Reese; *Aero Digest*, May 1, 1944, Vol. 45, No. 3, pp. 110–111, 224.

"The Shape of Post-War Personal Flight," Résumé of Papers Presented at Institute of Aeronautical Sciences National Light Aircraft Meeting, Detroit; *Aero Digest*, May 15, 1944, Vol. 45, No. 4, pp. 56–57, 237, 239.

Post-War Plans [including private flying] by John Hagen; *Air News*, June, 1944, Vol. 6, No. 5, pp. 52–54.

Here Lies Private Flying, by Devon Francis; *Skyways*, June, 1944, Vol. 3, No. 6, pp. 44–46, 92.

Research Safeguards the Future [Planning for Private Flying], by O. L. Parks; *Pegasus*, July, 1944, Vol. 4, pp. 1–5.

112,000 Private Planes Expected by Insurance Official after War; *American Aviation*, July 1, 1944, Vol. 8, No. 3, p. 49.

Suggestions for Furthering Private Flying, by J. H. Geisse; *Aeronautical Engineering Review*, August, 1944, Vol. 3, No. 8, pp. 47, 49, 51, 54, 59, 63.

What about Private Flying? by John Michel; *Flying Aces*, August, 1944, Vol. 48, No. 1, pp. 36–37, 62–63.

Making Flying Attractive to the Public, by Bernard Thyson; *Aviation Review*, September, 1944, Vol. 5, No. 9, pp. 15, 31.

What Was Wrong with Private Flying? Investigators Point Way to Post-War Planes by Finding That Pre-war Flying Was Too Expensive, Lacked Utility, by Charles E. Planck; *Flying*, September, 1944, Vol. 35, No. 3, pp. 30–31, 102, 105–106.

Minnesota Poll Shows Private Flying Plans; *Aviation News*, September 11, 1944, Vol. 2, No. 7, p. 18.

Morgan Outlines 5-point Program for Private Flying at National Aviation Clinic, Oklahoma City; *Aviation News*, November 20, 1944, Vol. 2, No. 17, pp. 16–17.

Private Flying's Plight, by J. E. Geisse; *National Aeronautics*, December, 1944, Vol. 22, No. 12, pp. 13–14, 20.

Readings on Post War Personal Aircraft, compiled by Norman Nicholson; Fort Worth, Globe Aircraft Corporation, 1944, 100 pp.

The Role of Personal Aircraft in Postwar Readjustment, by Joseph T. Geuting, Jr.; *In the* Aircraft Industry Prepares for the Future, Washington, D.C., Aeronautical Chamber of Commerce of America, Inc., 1944, pp. 31–36.

Aircraft and Economics of Private Flying, by R. M. Cleveland and L. E. Neville; *In their* Coming Air Age, New York, McGraw-Hill, 1944, pp. 193–235.

Why Fly? [discussion of private flying] by S. D. Thomson; Seattle, Wash., The Author, 1945, 30 pp.

You'll Fly—and You, and You; *Aviation and Yachting*; February, 1945, Vol. 12, No. 9, pp. 8–9.

What's Wrong With Flying? Better Planes, Better Rules, More Landing Fields Needed—U.S. Problems Same in Canada, by Lowell H. Swenson; *Aviation Review*, February, 1945, Vol. 6, No. 2, pp. 9, 33.

North Carolina Operator Sees Bright Future for Civilian Flying, by Haskell Deaton; *Contact*, March 22, 1945, Vol. 8, No. 9, p. 7.

Personal Planes, by Glenn A. Stearman; *Aviation and Yachting*, February, 1945, Vol. 12, No. 9, pp. 10, 20.

Will You Own Your Own Plane After the War? by E. Gordon; *House Beautiful*, March, 1945, Vol. 87, pp. 54–55.

Wallace's Decision to Fly Looms As Significant to Private Flying; *Aviation News*, March 26, 1945, Vol. 3, No. 9, p. 39.

Our Plan for Private Flying, by T. P. Wright; *Flying*, April, 1945, Vol. 36, No. 4, pp. 24–25, 123.

Planes Are Getting Personal, by Roland Cueva; *Mechanix Illustrated*, April, 1945, Vol. 33, No. 6, pp. 41–45, 66, 139; May, 1945, Vol. 34, No. 1, pp. 46–49, 139.

Personal Aircraft Owners As Envoys of International Goodwill, by E. W. Percival; *Aero Digest*, April 15, 1945, Vol. 49, No. 2, pp. 58–59.

Personal Plane Problems, by Joseph T. Geuting, Jr.; *Air News*, May, 1945, Vol. 8, No. 5, pp. 46, 49.

Let's Be Honest With Our Customers, by C. Friedlander; *Aviation*, May, 1945, Vol. 44, No. 5, pp. 114–115.

Opening the Sky, by A. S. Koch; *National Aeronautics*, May, 1945, Vol. 23, pp. 11, 21.

Wide Use of Planes for 100-mile Journeys Predicted by Burden [before Bond Club, Chicago]; *Civil Aeronautics Journal*, May 15, 1945, Vol. 6, pp. 49–50, 59.

Personal Flying and Its Importance to You, by John P. Morgan; *Cub Flier*, May-June, 1945, Vol. 9, No. 1, p. 2.

These Traffic Estimates Will Serve Operators and Producers; Predicting Travel Requirements in Commercial and Personal Planes, by W. Friedman; *Aviation*, June, 1945, Vol. 44, No. 6, pp. 174–175.

Secretary Wallace on Aviation, by Fred Hamlin; *Flying*, June, 1945, Vol. 36, No. 6, pp. 29–30.

Airlines and Private Flying, by Robert H. Wood; *Aviation News*, June 25, 1945, Vol. 3, No. 22, p. 46.

Private Flying Tomorrow; *Air Trails*, July, 1945, Vol. 24, No. 4, p. 14.

More Private Flying—More Jobs, by C. B. Monro; *Airports*, July, 1945, Vol. 8, No. 1, p. 56.

Aviation Executive Predicts 3,500,000 Private Pilots by 1960; *Contact*, July 5, 1945, Vol. 9, No. 11, p. 5.

Over 18,000 Private Planes in Operation [according to C.A.A.]; *Aviation News*, July 13, 1945, Vol. 7, No. 25, pp. 1, 7.

3,500,000 Private Pilots by 1960 Predicted for U.S., by William A. Mara; *American Aviation*, July 15, 1945, Vol. 9, No. 4, p. 42.

Private Flying, American Opportunity, by C. S. "Casey" Jones; *Air World*, September, 1945, Vol. 3, No. 6, p. 7.

CAA Reports Private Flying Boom Underway on West Coast; *Contact*, September 6, 1945, Vol. 10, No. 6, p. 1.

Personal Flying . . . the Sleeping Giant, an address by Alfred B. Bennett; *The Aero Tribune*, September 5, 1945, Vol. 1, No. 3, pp. 5–6.

Southwest Private Flight Boom Previews Vast Peace Expansion; *Aviation News*, September 10, 1945, Vol. 4, No. 7, p. 15.

Aviation's Role in America's Future, by Michael Walter; *Aero Digest*, September 15, 1945, Vol. 50, No. 6, pp. 37–39, 127.

AIRCRAFT AND EQUIPMENT

Airplanes

General

The Light Aeroplane of To-morrow. Present Trends and Future Possibilities in Design and Production, by J. P. Smith; *Flight*, September 7, 1939, Vol. 36, pp. 215–217.

Simpler Flying, by Fred E. Weick; *Southern Flight*, July, 1940, Vol. 14, No. 1, pp. 9, 12, 14.

Post-War "Family" Aircraft; *Flight*, October 30, 1941, Vol. 40, p. 296a.

Forecasting the Post-War Private Airplane, by Al Mooney; *Southern Flight*, October, 1941, Vol. 16, No. 4, pp. 12–13, 22–23.

Post-War "Flivver" Plane, by Adam Craigon; *Commercial Aviation*, Montreal, November, 1941, Vol. 3, No. 11, pp. 25–27.

A Plane in Every Garage? by Fillmore Hyde; *Air Facts*, January, 1942, Vol. 5, No. 1, pp. 11–16.

Skyways of the Future, by Alexis de Sakhnoffsky; *Skyways*, November, 1942, Vol. 1, pp. 16–17.

"Dear Mr. Manufacturer." Joe Doakes, Typical American, Has a Clear Idea of the Sort of Plane He Would Buy in Post-War Era. Here Are His Specifications, by Paul Pierce; *Flying*, December, 1942, Vol. 31, No. 6, pp. 55–56, 135–136.

Your Plane of the Future. Will It Be Gyro, Helicopter or Radical Fixed-Wing Type? Here's a Glance Ahead, by Charles H. Gale; *Air Progress*, March, 1943, Vol. 2, No. 3, pp. 15–17, 73.

Pony-Powered Lightplanes; Attractive Appearance, Low Horsepower and High Speed; *Air Progress*, May, 1943, Vol. 2, No. 5, pp. 10–11, 66.

Fabulous Phaetons of the Future, by Alexis de Sakhnoffsky; *Skyways*, May, 1943, Vol. 2, No. 4, pp. 14–15.

The Postwar Small Airplane and How to Increase Its Utility, by Peter Allman; *Automotive and Aviation Industries*, May 15, 1943, pp. 17–21, 84, 86.

My Plane of the Future, by Lloyd H. Sloan; *Canadian Aviation*, July, 1943, Vol. 16, No. 7, p. 60.

A Pilot's Private Thoughts on Future Private Planes, by Al Hansen; *Western Flying*, August, 1943, Vol. 23, No. 8, pp. 44–45, 100.

What the Postwar [private pilot] **Buyer Wants,** by J. H. Geisse; *Aviation*, September, 1943, Vol. 42, No. 9, pp. 116–117, 312–314.

Your Family Plane of Tomorrow, by Darrel Huff; *Better Homes and Gardens*, September, 1943, Vol. 22, No. 1, pp. 20–21, 78, 80–81.

What Kind of Airplane Do I Want after the War? [Replies by readers]; *Air Pilot and Technician*, September-November, 1943, Vol. 30, No. 3, pp. 28, 30, 32; No. 4, pp. 34–35, 37; No. 5, pp. 44–47.

Somebody Build Me This One! [Postwar air car] by Charles E. Planck; *Air Trails*, October, 1943, Vol. 21, No. 1, pp. 22–23, 76.

What Kind of Airplane Will You Fly Tomorrow? by W. T. Piper; *Southern Flight*, October, 1943, Vol. 20, No. 4, p. 31.

Postwar Private Planes; *Scientific American*, November, 1943, Vol. 169, No. 5, pp. 199–201.

Who'll Build My Omnibus, by Fred Smith; *Skyways*, November, 1943, Vol. 2, No. 11, pp. 24–25.

Don't Bank on Flying Flivvers, by Edward Churchill; *Coronet*, January, 1944, Vol. 15, No. 3, pp. 7–11.

An Expert Discusses . . . Postwar Private Planes . . . and Problems Involved, by William D. Hall; *Canadian Aviation*, February, 1944, Vol. 17, No. 2, pp. 56–57.

What Kind of Airplane Will You Fly Tomorrow, by F. E. Weick; *Southern Flight*, February, 1944, Vol. 21, No. 2, p. 52.

Memo to Operators; Here Are the Planes You May Be Selling in 1952; *American Pilot*, March, 1944, Vol. 5, pp. 14–15, 27.

What about That Post-War Plane? *American Pilot*, March, 1944, Vol. 5, pp. 10, 29.

Dream up Your Air Car! by Leonard Engel; *Air News*, May, 1944, Vol. 6, No. 5, pp. 17–20, 70.

The Post-War Private Airplane, by William D. Hall; *Aviation Review*, May, 1944, Vol. 5, No. 5, pp. 12, 22, 28.

Post-War Private Planes, by W. D. Hall; *Flying*, May, 1944, Vol. 24, No. 5, pp. 28–29, 108.

Objections to Present-Day Light Plane Listed by CAA's Flight Equipment Chief; *American Aviation*, May 15, 1944, Vol. 7, No. 24, p. 7.

Tomorrow's Private Planes, by Roel I. Wolfson; *Flying Aces*, June, 1944, Vol. 47, No. 3, pp. 24–25, 67–68.

F. T. Kurt, Grumman, Cites Private Pilots' Preferences; *SAE Journal*, June, 1944, Vol. 52, p. 42.

New Lightplane Specifications Worked out by Artillery Officers, by Blaine Stubblefield; *Aviation News*, June 19, 1944, Vol. 1, No. 47, p. 17.

Private-Owner Planes for the World, by William B. Stout; *Aero Digest*, August 15, 1944, Vol. 46, No. 4, pp. 84–85, 144.

The Future of the Light Aircraft, by J. H. Geisse; *Commercial Aviation*, September, 1944, Vol. 6, No. 7, pp. 38–44, 46, 48, 50, 55.

Public's Ideal Plane Specs Studied; survey by Aircooled Motors; *Aviation News*, September 18, 1944, Vol. 2, No. 8, p. 16.

Specifications for Ideal Plane Set by Buyers in Recent Manufacturers' Polls; *National Aeronautics*, October, 1944, Vol. 22, No. 10, p. 52.

A "Duffy" Speaks His Mind on the Postwar Airplane, by J. B. Clark; *Southern Flight*, October, 1944, Vol. 22, No. 4, p. 72.

Airplanes [light] **for Tomorrow,** by Walter Brennan; *Aviation and Yachting*, November, 1944, Vol. 12, No. 6, pp. 10–11.

We've Seen Some of the New Planes, by Bill Green; *Southern Flight*, November, 1944, Vol. 22, No. 5, pp. 22, 76.

The Private Airplane; Its Past and Future Analyzed; *U. S. Air Services*, November, 1944, Vol. 29, No. 11, pp. 20, 22, 52.

Air Progress; Development of Lightplanes, by Douglas Rolfe; *Air Trails*, December, 1944, Vol. 23, No. 3, pp. 36–37.

Two Planes That Open a New World for Postwar Private Flyers, Popular Science postwar plane contest winners; *Popular Science*, December, 1944, Vol. 145, No. 6, pp. 84–89.

Descriptions and Data of a Few of the Personal Planes Which Will Be Available After the War; *Weight Engineering*, Winter, 1944, Vol. 2, No. 4, pp. 8–20.

So—You Want to Own an Airplane; *Weight Engineering*, Winter, 1944, Vol. 2, No. 4, pp. 5–7.

Role of the Personal Airplane in Tomorrow's Aviation. *In* National Clinic for Domestic Aviation Planning. Second Annual Meeting *Proceedings*, Washington, D.C., 1944, pp. 59–102.

The Standard Guide to Private Planes, by Lester Ott; New York, Aeronautics Publishing Associates, 1945, 128 pp.

Your Personal Plane, by John Paul Andrews, introduction by Henry A. Wallace, illustrated by Robert Lundgren. New York, Duell, Sloan & Pearce, 1945, 240 pp.

Another "$700" Airplane? *Southern Flight*, January, 1945, Vol. 23, No. 1, pp. 26–27, 42.

Post-War Air Jeeps; *Aeroplane*, January 12, 1945, Vol. 68, p. 59.

Personal Planes, by C. J. Hawkins; *Air Tech*, February, 1945, Vol. 6, No. 2, pp. 46–48.

American Aircraft [including private planes]; *Aviation*, February, 1945, Vol. 44, No. 2, pp. 141–148, 183–184.

The Post-War Plane, by J. C. Ward; *National Aeronautics*, February, 1945, Vol. 23, No. 2, pp. 16–17, 20.

Post-War Private Planes; *Traffic World*, February 24, 1945, Vol. 75, No. 8, p. 482.

One or Two Engines? by H. Piper; *Air Facts*, March, 1945, Vol. 8, No. 3, pp. 28–31.

Your Postwar Plane, by Keith Edgar; *Canadian Aviation*, March, 1945, Vol. 18, No. 3, pp. 43, 98.

Toward a Better Lightplane, by S. J. Stelle; *Flying*, March, 1945, Vol. 36, No. 3, pp. 53–54, 78, 80, 84.

These Are the Planes You'll Fly After the War; *Popular Science*, March, 1945, Vol. 146, No. 3, pp. 100–11.

Here's Your Personal Plane; *Air News*, April, 1945, Vol. 8, No. 4, pp. 18–20.

Skyway's Preview of Postwar Personal Planes; *Skyways*, April, 1945, Vol. 4, No. 4, pp. 43–63.

Airport Pilot—or Cross-Country Cruiser, by Jack Andresen; *Skyways*, April, 1945, Vol. 4, No. 4, pp. 27, 80.

Designs for GI Joe, by Vernon Payne; *Air Trails*, April, 1945, Vol. 24, No. 1, pp. 40–41, 94–95.

Make My Plane Useful, by Charles Evans; *Flying*, April, 1945, Vol. 36, No. 4, pp. 51–52, 150–152.

Postwar Planes, How "New" New Planes Will Be Arouses Industry Debate; *National Aeronautics*, April, 1945, Vol. 23, No. 4, p. 39.

American Civil Aircraft [planned for early postwar production]; *Western Flying*, April, 1945, Vol. 25, No. 4, pp. 103–118.

American Civil Aircraft [out of production but in service]; *Western Flying*, April, 1945, Vol. 25, No. 4, pp. 119–126.

Your Post War Private Plane; *Air World*, May, 1945, Vol. 3, No. 4, pp. 37, 47, 49.

One Pilot's Plane . . .; *Skyways*, May, 1945, Vol. 4, No. 5, pp. 40–41.

Private Flyers Look Ahead [Zimmer-Thomson poll on private flying] by John B. Thomson; *Skyways*, May, 1945, Vol. 4, No. 5, pp. 39, 78.

Aviation Industry Is Studying Trends of Public Thought on Private Plane; *Civil Aeronautics Journal*, May 15, 1945, Vol. 6, No. 5, pp. 49, 60.

Here Are the Results of AOPA Survey; *AOPA Pilot*, June, 1945, pp. 72a–72c.

New Planes? *National Aeronautics*, June, 1945, Vol. 23, No. 6, p. 39.

Wings for the Family, by T. P. Wright; *Popular Mechanics*, June, 1945, Vol. 83, No. 6, pp. 33–37, 154.

Your Personal Air-Car, by Ed Yulke; *Skyways*, June, 1945, Vol. 4, No. 6, pp. 25, 68.

Low-Wing Personal Plane, by R. G. Naugle; *Western Flying*, June, 1945, Vol. 25, No. 6, pp. 40–41, 96.

SAE Discusses Lightplanes, by F. M. Reck; *Aero Digest*, June 15, 1945, Vol. 49, No. 6, p. 46.

AOPA Pilots Answer Questionnaire on Postwar Planes; *American Aviation Daily*, Washington, D.C., June 12, 1945, Vol. 39, p. 199.

Montreal Man Describes "Ideal" Private Plane; *Canadian Aviation*, July, 1945, Vol. 18, No. 7, p. 62.

The Postwar Plane I Want; It Should Have Standardized Controls, by Herb Packer; *Aviation Service*, July-August, 1945, pp. 11, 44.

What Does the Private Owner Want? by Indicator; *Flight*, July 12, 1945, Vol. 48, pp. 38–39.

Better Lightplanes for Tomorrow, by T. B. Woodbury; *Aero Digest*, July 15, 1945, Vol. 50, No. 2, p. 48.

A Small Plane Is Transportation, by George V. Caesar; *Air Facts*, August, 1945, Vol. 8, No. 8, pp. 38–41.

Flying's Airsedan; *Flying*, August, 1945, Vol. 37, No. 2, pp. 34–94, 97–98.

What Does the Private Owner Want? Signed J. R. Bryans; *Flight*, August 9, 1945, Vol. 48, p. 158.

Your Small Plane of the Future, by William B. Stout; *Air Trails*, October, 1945, Vol. 25, No. 1, pp. 24–25, 92–95.

Your Postwar Personal Plane; *Airman*, October, 1945, Vol. 1, No. 11, pp. 9–12.

Preview of Light Planes, by Dorothy Miller; *Capper's Farmer*, October, 1945, Vol. 56, No. 10, pp. 13, 52–53.

Individual Models

Newest West Coast Plane is Aero Design Commander, by Scholer Bangs; *Aviation News*, July 9, 1945, Vol. 3, No. 24, pp. 18, 20.

They Made Their Bow [Aeronca Super Chief]; *Sportsman Pilot*, July 15, 1940, Vol. 24, No. 1, pp. 19, 48.

The Sportsman Test Pilot, James B. Taylor, Jr., Flies the Continental 65-powered Aeronca Super Chief and the Lycoming 65-powered

Trainer; *Sportsman Pilot*, January 15, 1941, Vol. 25, No. 1, pp. 14-15, 47-48.

Aeronca Defender; *Aviation*, December, 1941, Vol. 40, No. 12, pp. 110, 202.

Our Postwar Lightplane [Aeronca], by Carl Friedlander; *Air Trails*, November, 1943, Vol. 21, No. 2, pp. 22-23, 77, illus.

Aeronca, the Plane You'll Want to Fly; Middletown, Ohio, Aeronca Aircraft Corporation, 1945, 28 pp.

Aeronca Suggestion for the Future; *Aviation News*, January 24, 1944, Vol. 1, p. 35.

How to Make Small Airports Pay with . . . Aeronca. Middletown, Ohio, Aeronca Aircraft Corporation, 1945. 24 pp.

Aeronca Presents Chum 2-Placer; *Aviation*, March, 1945, Vol. 44, No. 3, p. 173.

Aeronca's Chum First Post-War Plane Using Ercoupe's Dual Control, by Alexander McSurely; *Aviation News*, March 5, 1945, Vol. 3, No. 6, pp. 15-16.

Aeronca's Latest Postwar Announcement: the "Foolproof" Chum; *Airman*, April, 1945, Vol. 1, No. 6, pp. 3-4.

Evolution of the Aeronca, by Victor Boesen; *Skyways*, April, 1945, Vol. 4, No. 4, pp. 34-41, 88.

First Post-War Airplane off Aeronca Assembly Line Sept. 5; *Contact*, September 6, 1945, Vol. 10, No. 6, p. 1.

Aeronca Champion Will Sell for $2095; New Craft Features Greater Visibility; *American Aviation*, October 1, 1945, Vol. 9, No. 9, p. 38.

Allied Aviation Builds 3-Place Twin-Engine Light Amphibian, by Blaine Stubblefield; *Aviation News*, July 10, 1944, Vol. 1, No. 50, pp. 17-18.

All American Aircraft to Build Light Plane; *American Aviation*, September 15, 1945, Vol. 9, No. 8, p. 40.

Experimental Single-Seater [Aviation Booster's Skyhopper]; *Southern Flight*, May, 1945, Vol. 23, No. 5, pp. 33, 70.

New One-Place Lightplane [Aviation Booster] is Market Question Mark; *Aviation News*, May 14, 1945, Vol. 3, No. 16, pp. 48-49.

"Skyhopper" Plane Features Economy; *Canadian Aviation*, June, 1945, Vol. 18, No. 6, p. 86.

$1,000 Plane [Aviation Booster's Skyhopper] Offered by Kansas City Firm; *American Aviation*, July 1, 1945, Vol. 9, No. 3, p. 47.

The Skyhopper; *Air Tech*, August, 1945, Vol. 7, No. 2, pp. 38, 68.

The Cruisair [Bellanca]; *Air News*, August, 1945, Vol. 9, No. 2, p. 44.

Bellanca Plans 4-Place 'Cruisair' at $4,500; *American Aviation*, August 1, 1945, Vol. 9, No. 5, p. 44.

Post-War Bellanca is 'Luxury' Model; *Aviation News*, August 6, 1945, Vol. 4, No. 2, pp. 40, 42.

High Altitude Callair is Newcomer in Personal Plane Field, by Alexander McSurely; *Aviation News*, March 12, 1945, Vol. 3, No. 7, p. 27.

Commonwealth "Skyranger" to Be in Production before Sept. 30; *Contact*, September 20, 1945, Vol. 10, No. 8, p. 3.

They Make Their Bow [Culver Cadet]; *Sportsman Pilot*, July 15, 1940, Vol. 24, No. 1, pp. 48, 50.

James B. Taylor, Jr., Flies the Continental-75-powered Culver Cadet; *Sportsman Pilot*, October 15, 1940, Vol. 24, No. 4, pp. 14-15, 30.

Franklin-Powered Culver; *Aviation*, April, 1941, Vol. 40, No. 4, p. 83.

Culver Studies Plan for Safe Easy-to-Fly Personal Plane; *Aviation News*, March 5, 1945, Vol. 3, No. 6, pp. 26, 30.

Air Tech Presents the Culver; *Air News*, October, 1945, Vol. 9, No. 4, pp. 53-57.

How to Fly the Culver, by W. R. Sutherland; *Air News*, October, 1945, Vol. 9, No. 4, pp. 46-48.

Ercoupe; *Air Facts*, May, 1940, Vol. 3, No. 5, pp. 19-33.

The Sportsman Test Pilot, James B. Taylor, Jr., Flies the Continental-Powered Ercoupe; *Sportsman Pilot*, May 15, 1940, Vol. 23, No. 5, pp. 12-13, 28.

Flight Training on the Ercoupe, by W. W. Woods; *Air Facts*, September, 1940, Vol. 3, No. 9, pp. 13-19.

Fly It Yourself; Ercoupe, by Richard Thruelsen; *National Aeronautics*, January, 1941, Vol. 19, No. 1, p. 11.

"Home on the Range"—in an Ercoupe, by Selby Calkins; *Western Flying*, March, 1941, Vol. 21, No. 3, pp. 26-28, 37.

Phenomenal Flivver [Ercoupe] by John C. A. Watkins; *Flying*, April, 1941, Vol. 28, No. 4, pp. 26-27, 74, 76, 78.

Development of the Ercoupe, an Airplane for Simplified Private Flying, by Fred E. Weick; *SAE Journal* (Transactions), December, 1941, Vol. 48, pp. 520-531.

Postwar Business No Problem to Builders of Ercoupe Planes, by Blaine Stubblefield; *Aviation News*, April 24, 1944, Vol. 1, No. 39, pp. 15-16.

Four Years of Simpler Flying with the Ercoupe, paper presented by Fred E. Weick before Society of Automotive Engineers, Los Angeles, October 5-7, 1944. 12 pp.

Ercoupe—a Plane with a Future, by D. C. Alexander; *Air News*, January, 1945, Vol. 8, No. 1, pp. 30-31.

Simpler Flying [Ercoupe]; *Flight*, February 1-8, 1945, Vol. 47, pp. 123-125, 152-155.

That Weick Patent, by Edward Doherty, Jr.; *Flying*, June, 1945, Vol. 39, No. 6, pp. 46-47, 96, 100, 104.

Evolution of the Ercoupe, by Alec Walker; *Skyways*, July, 1945, Vol. 4, No. 7, pp. 34-40, 78.

Ercoupe Scheduled for Production by Early 1946; *American Aviation*, August 15, 1945, Vol. 9, No. 6, p. 38.

The Ercoupe—; *Air Ads*, August 20, 1945, Vol. 2, No. 3, pp. 1-2.

First New Ercoupe Delivered; Performance Boosts Announced; *Aviation News*, October 8, 1945, Vol. 4, No. 11, p. 36.

New Four-Place "Aircruiser" [Eshelman Flying Wing]; *Aero Digest*, July 1, 1944, Vol. 46, No. 1, p. 98.

The [Eshelman] **"Winglet"—New Lightplane**; *Aero Digest*, June 15, 1945, Vol. 49, No. 6, p. 102.

The [Eshelman] **Winglet**; *Air News*, October, 1945, Vol. 9, No. 4, p. 45.

The Sportsman Test Pilot, James B. Taylor, Jr., Flies the Ranger- and Warner-Powered Fairchild M-62; *Sportsman Pilot*, February 15, 1941, Vol. 25, No. 2, pp. 12-13, 41.

Fairchild Builds 4-Place Prototype for Post-war Personal Market; *Aviation News*, December 11, 1944, Vol. 2, No. 20, p. 10.

Post-War "Family" Plane [Fairchild M-84]; *Aviation Review*, April, 1945, Vol. 6, No. 4, p. 9.

Service, Two-Place Lightplane is Funk's Bid for Peace Sales; *Aviation News*, June 18, 1945, Vol. 3, No. 21, p. 37.

The New Funk B-75-L; *Airman*, September, 1945, Vol. 1, No. 10, p. 7.

The General "Skyfarer"; *Aero Digest*, June, 1941, Vol. 38, No. 5, pp. 169-170.

A New Plane to Make Every Man a Pilot; *Aviation*, June, 1941, Vol. 40, No. 5, pp. 137, 186.

Skyfarer; *Air Facts*, July, 1941, Vol. 4, No. 7, pp. 14-23.

They Make Their Bow [General Skyfarer]; *Sportsman Pilot*, June 15, 1941, Vol. 25, No. 6, pp. 22-23, 43.

The Skymobile is Here! by Joet Wynfield; *Flying Aces*, December, 1941, Vol. 40, No. 1, pp. 21, 80.

The Sportsman Test Pilot, James B. Taylor, Jr., Flies the Geared Lycoming-75-powered General Skyfarer; *Sportsman Pilot*, August, 1941, Vol. 26, No. 2, pp. 14-15, 46.

Two New Lightplanes Headline General's Post-War Program, by Blaine Stubblefield; *Aviation News*, May 15, 1944, Vol. 1, No. 42, pp. 16-17.

Don't Look Now But . . . [General Aircraft Skyfarer] by Marguerite Bryan; *Air Facts*, February, 1945, Vol. 8, No. 2, pp. 22-24.

The Swift; Fort Worth, Globe Aircraft Corporation, 1944. 16 pp.

New Prototype of Globe Swift May be Flight-Tested Next Month, by Alexander McSurely; *Aviation News*, December 11, 1944, Vol. 2, No. 20, pp. 23-24.

Globe's New Swift; *Airman*, January, 1945, Vol. 1, No. 3, pp. 3-4.

Swift Powerplant Raised to 115-hp; *Aviation News*, September 10, 1945, Vol. 4, No. 7, p. 14.

First Swift Completed; Globe Has $10,000,000 Backlog; *American Aviation Daily*, October 2, 1945, Vol. 41, p. 150.

Decade-Old Hammond Lightplane is "Newest" Market Challenger, by Alexander McSurely; *Aviation News*, May 7, 1945, Vol. 3, No. 15, pp. 17-18.

Hockaday Comet—Personal Aircraft; *Commercial Aviation*, April, 1945, Vol. 7, No. 3, p. 53.

The Sportsman Test Pilot, James B. Taylor, Jr., Flies the Continental-Powered Interstate Cadet; *Sportsman Pilot*, May 15, 1941, Vol. 25, No. 5, pp. 16-17.

Interstate Cadet Clinic, by Selby Calkins; *Western Flying*, June, 1941, Vol. 21, No. 6, pp. 28-30, 47.

Interstate Cadet; *Air Facts*, November, 1941, Vol. 4, No. 11, pp. 27-34.

Newest High-Speed Lightplane [Jarvis VJ-21], Set for under $2,000 Cost, by Schoier Bangs; *Aviation News*, July 23, 1945, Vol. 3, No. 26, pp. 27-28.

Jarvis VJ-21, Two-Place Pusher Has 'Bicycle Type' Landing Gear; *American Aviation*, August 1, 1945, Vol. 9, No. 5, p. 46.

Jarvis Firm Introducing VJ-21 Two-Placer; *Aviation*, September, 1945, Vol. 44, No. 9, p. 175.

Design for Tomorrow; the Rocket A-75; *Aviation*, June, 1944, Vol. 43, No. 6, p. 188.

New Johnson Rocket Ready for Production; Craft with 185 hp. or 140 hp. Engines Optional; *Aviation News*, October 30, 1944, Vol. 2, No. 14, p. 18.

Johnson Rocket Called Highly Satisfactory after Tests, by Alexander McSurely; *Aviation News*, February 26, 1945, Vol. 3, No. 5, p. 35.

Langley Bi-motor; *Air Facts*, November, 1941, Vol. 4, No. 11, pp. 46-49.

They Make Their Bow [Langley]; *Sportsman Pilot*, November, 1941, Vol. 26, No. 5, pp. 28, 40.

The Langley, by Leighton Collins; *Air Facts*, August 1, 1945, Vol. 8, No. 8, pp. 54, 60-68.

They Make Their Bow [Luscombe Silvaire]; *Sportsman Pilot*, May 15, 1940, Vol. 23, No. 5, p. 50.

James B. Taylor, Jr., Flies the Continental 75-Powered Luscombe Silvaire; *Sportsman Pilot*, August 15, 1940, Vol. 24, No. 2, pp. 12-13, 28.

Improved Luscombe Silvaire Prepared for Post-War Market, by Blaine Stubblefield; *Aviation News*, October 23, 1944, Vol. 2, No. 13, pp. 16-17.

Offer Power Option in New Lightplane [Midwest Mercury]; *Aviation News*, June 4, 1945, Vol. 3, No. 19, p. 22.

The Miles "Messenger"; *Commercial Aviation*, June, 1945, Vol. 7, No. 5, pp. 94, 102.

British Military Plane [Miles Messenger] **Seen as Private Craft**; *Civil Aeronautics Journal*, July 15, 1945, Vol. 6, No. 7, p. 74.

The Naugle Lightplane; *Aero Digest*, December 15, 1944, Vol. 47, No. 6, pp. 85-87.

North American Lightplane Revealed; Low Price Seen, by Scholer Bangs; *Aviation News*, September 24, 1945, Vol. 4, No. 9, pp. 13-14.

Payen Revived; *Flight*, September 16, 1943, Vol. 44, p. 310.

Two New Cubs; *Air Facts*, January, 1940, Vol. 3, No. 1, pp. 13-20.

Piper's Light Plane; *Fortune*, June, 1940, Vol. 21, No. 6, pp. 77-80, 113-114, 116, 118.

James B. Taylor, Jr., Flies the Continental 75-Powered Piper Cruiser; *Sportsman Pilot*, November 15, 1940, Vol. 24, No. 5, pp. 13, 37.

James B. Taylor, Jr., Flies the Continental 65-Powered Piper Cub Coupe; *Sportsman Pilot*, November 15, 1940, Vol. 24, No. 5, pp. 12-13.

They Make Their Bow [Piper Coupe]; *Sportsman Pilot*, February 15, 1941, Vol. 25, No. 2, pp. 22-23, 48.

Piper Cruiser; *Air Facts*, May, 1941, Vol. 4, No. 5, pp. 27-33.

They Make Their Bow [Piper Cruiser]; *Sportsman Pilot*, November, 1941, Vol. 26, No. 5, pp. 28, 40.

New Piper PT Low-Wing Designed to Perform Multipurpose Duties; *The Cub Flier*, January, 1944, Vol. 7, p. 2.

Piper Developments Watched for Hint of Post-War Pattern, by Blaine Stubblefield; *Aviation News*, June 12, 1944, Vol. 1, No. 46, pp. 16, 18.

Piper Tests New 4-Place, 1-Place Planes for Post-War Market, by Alexander McSurely; *Aviation News*, January 29, 1945, Vol. 3, No. 1, pp. 38-39.

Piper to Build One and Four Place Low Wing Models for Postwar Use; *American Aviation*, February 1, 1945, Vol. 8, No. 17, pp. 49-50.

Piper's New Experimental Planes; *Aero Digest*, February 15, 1945, Vol. 48, No. 4, p. 99.

Air Tech Presents the Piper Cub, Your Personal Post-War Plane; *Air Tech*, March, 1945, Vol. 6, No. 3, pp. 16-17, 74.

Piper Designs New Skysedan and Skycycle; *Aviation*, March, 1945, Vol. 44, No. 3, p. 172.

Skycycle [Piper PA-8] **for One**, by Martin Caidin; *Air News*, July, 1945, Vol. 9, No. 1, pp. 18-19.

Experiment by Piper, by Budd Stone; *Air Trails*, August, 1945, Vol. 24, No. 5, pp. 35-36, 74-78.

Skycycle Built for One [Piper PA-8], by Martin Caidin; *Mechanix Illustrated*, August, 1945, Vol. 34, No. 4, pp. 52-53.

Is This What They Want? Piper Skycoupe; *Flight*, August 30, 1945, Vol. 48, pp. 230-231.

They Make Their Bow [Rearwin Cloudster]; *Sportsman Pilot*, February 15, 1940, Vol. 23, No. 2, pp. 16-17.

The Sportsman Test Pilot, James B. Taylor, Jr., Flies the Ken-Royce-Powered Rearwin Cloudster; *Sportsman Pilot*, July 15, 1940, Vol. 24, No. 1, pp. 12-13, 28.

They Make Their Bow [Rearwin Ranger]; *Sportsman Pilot*, July 15, 1940, Vol. 24, No. 1, p. 50.

Rearwin Ranger; *Air Facts*, January, 1941, Vol. 4, No. 1, pp. 12-18.

Plane for Tomorrow [Skycraft Model 445], by D. Newell Ahnstrom; *Skyways*, July, 1945, Vol. 4, No. 7, pp. 24-25.

Skycraft Lightplane [Skylark Manufacturing Co.] **Nears Auto Comfort**; *Aviation News*, August 20, 1945, Vol. 4, No. 4, pp. 36, 38.

Southeastern's New Program Starting; *Aviation News*, July 10, 1944, Vol. 1, No. 50, p. 18.

Spartan Executive Returns to Market; *Aviation News*, June 25, 1945, Vol. 3, No. 22, p. 15.

Lloyd Stearman Prepares Postwar Family Airplane; *American Aviation*, February 15, 1944, Vol. 7, No. 18, p. 34.

They Make Their Bow [Stinson 105]; *Sportsman Pilot*, February 15, 1940, Vol. 23, No. 2, pp. 17, 34.

The "105" [Stinson] **for Forty;** *Air Facts*, April, 1940, Vol. 3, No. 4, pp. 14–19.

The Sportsman Test Pilot, James B. Taylor, Jr., Flies the Franklin 90-Powered Stinson Voyager; *Sportsman Pilot*, March 15, 1941, Vol. 25, No. 3, p. 12.

Stinson "Voyager"; *Aero Digest*, March, 1941, Vol. 38, No. 3, pp. 243, 244.

Stinson Voyager, by Jerome Jacobs; *Flying Aces*, July, 1941, Vol. 38, No. 4, pp. 46–47.

Air Tech Presents the Stinson Voyager; *Air Tech*, August, 1945, Vol. 7, No. 2, pp. 15–25.

Stinson Means Business; *Plane Talk*, August 1945, Vol. 3, No. 5, pp. 4–5.

Stinson Offers New Planes and Replacements; *Commercial Aviation*, July, 1945, Vol. 7, No. 6, p. 90.

New Advanced Plane [Stinson 150] **for Private Flying;** *Science News Letter*, September 29, 1945, p. 207.

Stout Develops Unorthodox Pusher Type Personal Aircraft, by Alexander McSurely; *Aviation News*, March 26, 1945, Vol. 3, No. 9, pp. 35-36.

Removable Wings and Tricycle Gear Featured on Sport Plane [Swedish SAAB-91]; *American Aviation*, April 15, 1945, Vol. 8, No. 22, p. 80.

They Make Their Bow [Taylorcraft De Luxe]; *Sportsman Pilot*, January 15, 1941, Vol. 25, No. 1, pp. 24–25, 28.

Taylorcraft [Duotone Deluxe] **Tryout,** by Selby Calkins; *Western Flying*, May, 1941, Vol. 21, No. 5, pp. 28–30.

Two Taylorcraft Models Ready for Production after War Ends, by Blaine Stubblefield; *Aviation News*, June 5, 1944, Vol. 1, No. 45, pp. 16–17.

Taylorcraft's Post-War Plans; *Airman*, November, 1944, Vol. 1, No. 1, pp. 10–11.

Taylorcraft's "Family"; *Commercial Aviation*, January, 1945, Vol. 6, No. 11, pp. 55–56.

Prospective Plane Owners Study 4-Place Taylorcraft Prototype, by Blaine Stubblefield; *Aviation News*, February 5, 1945, Vol. 3, No. 2, pp. 15–16.

Designed for the Private Flyer [Taylorcraft Model 15]; *Aviation Review*, March, 1945, Vol. 6, No. 3, p. 12.

Taylorcraft's 'Family Plane' Bid: the Four-Place Model 15; *Airman*, June, 1945, Vol. 1, No. 8, pp. 4–5.

Roadable Types

Airplanes on the Highway, by William B. Stout and Franklin M. Reck; *in their* Tomorrow We Fly, New York, 1943, pp. 68–78.

Bill Stout Designs Planes for the Postwar Family; *American Aviation*, August 15, 1943, Vol. 7, No. 6, p. 37.

The Wizard of Dearborn Is 'At It Again,' by Paul James; *Canadian Aviation*, September, 1943, Vol. 16, No. 8, pp. 74, 76.

Bill Stout says . . .; *Southern Flight*, September, 1943, Vol. 20, No. 3, pp. 24, 34.

Up Bill Stout's Sleeve [discussion of post-war airplane] by Howard Stephenson; *Plane Talk*, September, 1943, pp. 9–11.

Designer Stout Outlines Ideas on Probable Post-War Plane Types; *Western Flying*, September, 1943, Vol. 23, No. 9, p. 126.

Bill Stout! Sky Prophet. A Fantastic Man? Yes, but Only Because He Lives in the Future. He Discusses His Post-War Planes, by Howard Stephenson; *Forbes Magazine*, September 1, 1943, Vol. 52, No. 5, p. 18.

Roadable Airplanes, by R. H. Upson; *Air Facts*, January, 1944, Vol. 7, No. 1, pp. 40–44.

Roadable Plane's Utility Compared with That of Pure Aircraft; *Aviation News*, August 28, 1944, Vol. 2, No. 5, pp. 11–12.

Plane-Auto Merger Proposed [by York Research Corp.]; *Western Flying*, September, 1944, Vol. 24, No. 9, p. 54.

Wing Talk [discussion of roadable airplane], by Frederick R. Neely; *Collier's*, January 6, 1945, Vol. 115, No. 1, p. 8.

The Wizard [Bill Stout] **Predicts,** by Keith Edgar; *Canadian Aviation*, February, 1945, Vol. 18, No. 2, pp. 60–61, 116.

Planes Along the Highways; *Air News*, March, 1945, Vol. 8, No. 3, pp. 30–32.

Ottawa Man Invents . . . Roadable Plane . . . with Novel Features; *Canadian Aviation*, April, 1945, Vol. 18, No. 4, p. 71.

Flying Automobile, by H. Piper; *Air Facts*, May 1, 1945, Vol. 8, No. 5, pp. 56–60.

The Roadable Airplane, by W. B. Stout; *Air Facts*, July, 1945, Vol. 8, No. 7, pp. 28–34.

First Roadable Helicopter Completed in Los Angeles, by Scholer Bangs; *Aviation News*, July 2, 1945, Vol. 3, No. 23, p. 12.

Road-Running Airplane, by H. G. Graybill; *Air Facts*, August 1, 1945, Vol. 8, No. 8, pp. 17–18, 20–22.

Stout Designs Peacetime Air Cars; *Aviation News*, August 2, 1945, Vol. 4, No. 1, p. 22.

W. B. Stout Still Working on Roadable-Type Aircraft; *American Aviation*, August 15, 1945, Vol. 9, No. 6, p. 36.

Three-Unit Aircar Design [by Herbert D. Boggs], described by Blaine Stubblefield; *Aviation News*, August 27, 1945, Vol. 4, No. 5, p. 46.

C[urtis] **W**[right] **Industries 'Copter Is Two-Place Roadable;** *Aviation*, September, 1945, Vol. 44, No. 9, pp. 172–173.

Four-Place [Airmaster] **Air-Car Is New Roadable Project;** *Aviation*, September, 1945, Vol. 44, No. 9, pp. 174–175.

"An Airplane in Every Garage," by Daniel R. Zuck; *Aero Digest*, September 15, 1945, Vol. 50, No. 4, pp. 53–55, 124.

Design

Tomorrow's Light Plane Will Have These Features, Says William B. Stout; *Aviation*, June, 1940, Vol. 39, No. 6, pp. 36–37, 110.

New Developments in Simplified Control, by Ralph H. Upson; *Journal of the Aeronautical Sciences*, December, 1942, Vol. 9, No. 14, pp. 515–520, 548.

The Postwar Small Airplane and How to Increase Its Utility, by Peter Altman; *Automotive and Aviation Industries*, May 15, 1943, Vol. 88, No. 10, pp. 17–21, 84, 86.

Weight Control in Small Aircraft; *Weight Engineering*, Winter, 1943, Vol. 1, pp. 6–8.

Fixed-Wing Type Seen Dominating Post-War Private Airplane Field; *American Aviation*, January 15, 1944, Vol. 7, No. 16, p. 80.

Spin-Resistant Models Studied for Post-War Private Plane Market; abstract of paper by William D. Hall; *Aviation News*, January 17, 1944, Vol. 1, No. 25, p. 24.

Lightplane Manufacturer Looks to Post-War Design; *Skyways*, March, 1944, Vol. 3, No. 3, pp. 36–37.

Mr. Designer, Let's Be Practical, by Robert J. Whittier; *Air Pilot and Technician*, May, 1944, Vol. 31, No. 5, pp. 4–7.

Future of the Private Plane Lies in Developing New Ideas, Not in Refining Old Ones, Says Geisse; *National Aeronautics*, May, 1944, Vol. 22, pp. 41–42.

Lightplane Leaders Discuss Design Outlook at Detroit Meeting, by Blaine Stubblefield; *Aviation News*, May 8, 1944, Vol. 1, No. 41. pp. 20–21.

The Shape of Post-War Personal Flight [report on Institute of Aeronautical Sciences Light Aircraft Meeting, Detroit]; *Aero Digest*, May 15, 1944, Vol. 45, No. 4, pp. 56–57, 237, 239.

Safe Utility Plane Will Stay Sold, Geisse Tells Light Aircraft Makers; *Civil Aeronautics Journal*, May 15, 1944, Vol. 5, p. 56.

Weight Control in Small Airplanes; *Aero Digest*, August 1, 1944, Vol. 46, No. 3, pp. 92, 94, 96.

Unit Cabins to Increase Comfort of Light Aircraft, by K. B. Turner; *Aeronautical Engineering Review*, September, 1944, Vol. 3, No. 9, pp. 9, 11, 23.

Save Money by Spending It—on Flaps and Retractable Gear, by Ralph H. Upson; *Aviation*, September, 1944, Vol. 43, No. 9, pp. 130–131, 241–242.

Quiet,—Please, by Leighton Collins; *Air Facts*, October, 1944, Vol. 7, No. 10, pp. 28–30.

Tomorrow's Light Aircraft [signed Indicator]; *Flight*, October 19–26, 1944, Vol. 46, pp. 418–419, 453–454.

Postwar Civil Aircraft Design; Professional and Amateur Prize-winning Designs in "Popular Science Monthly" Competition; *Commercial Aviation*, November, 1944, Vol. 6, No. 9, pp. 62, 64, 68.

Make Flying Easier, by Edward E. Slattery, Jr.; *Flying*, November, 1944, Vol. 35, No. 5, pp. 30–31, 118, 134.

Designs by Buyers, by C. B. Colby; *Southern Flight*, November, 1944, Vol. 22, No. 5, pp. 34–35.

Basic Arrangement of the Modern Private Airplane, by R. G. Naugle; *Western Flying*, November, 1944, Vol. 24, No. 11, pp. 48–50, 94, 100.

Folding Wings Feature Planck Design; *Aviation News*, November 6, 1944, Vol. 2, No. 15, p. 21.

Engineering Your Personal Plane, by Edward R. Burn; *Air Trails*, December, 1944, Vol. 23, No. 3, pp. 28–29, 82–87.

The Canard Plane for the Private Pilot, by R. G. Naugle; *Western Flying*, December, 1944, Vol. 24, No. 12, pp. 50–52, 116, 118.

Wing Flaps in Light Aircraft Designs, by M. A. Garbell; *Journal of the Aeronautical Sciences*, January, 1945, Vol. 12, No. 1, pp. 14–20.

Continental's Annual Design Competition [1944 winners]; *Aero Digest*, January 15, 1945, Vol. 48, No. 2, pp. 83–85.

Structural Design Problems of Light Aircraft, by S. J. Stelle; *Aeronautical Engineering Review*, February, 1945, Vol. 4, No. 2, pp. 29, 31–32, 37.

Toward a Better Lightplane, by Stanford J. Stelle; *Flying*, March, 1945, Vol. 36, No. 3, pp. 53–54, 78.

Controllable Wing Plane, Test Flown [Convair]; *American Aviation*, April 15, 1945, Vol. 8, No. 22, p. 90.

Testing the Controllable [Spratt] **Wing;** *Plane Talk*, May, 1945, Vol. 3, No. 3, pp. 10–11.

Design Considerations of the Low-Wing Personal Plane, by Richard G. Naugle; *Western Flying*, May, 1945, Vol. 25, No. 5, pp. 44–46, 76.

Private Owner Designs; *Flight*, May 3, 1945, Vol. 47, pp. 470–472.

Aviation Industry is Studying Trends of Public Thought on Private Plane; Raymond B. Maloy in address before Society of Automotive Engineers, Detroit; *Civil Aeronautics Journal*, May 15, 1945, Vol. 16, pp. 49, 60.

Candid Comments [on light aircraft design]. *Aeronautics*, June, 1945, Vol. 12, No. 5, pp. 52–53

Spratt Controllable Wing, by Arnold Romney; *Air Tech*, June, 1945, Vol. 6, No. 6, pp. 48, 62.

Engineering Problems in Small Aircraft Design, by Willis M. Hawkins, Jr.; *Industrial Aviation*, June, 1945, Vol. 2, No. 6, pp. 46–48, 50, 96–97.

Trends in Personal Aircraft Design, by C. G. Taylor; *Aero Digest*, June 1, 1945, Vol. 49, pp. 54–55, 150.

Designing Tomorrow's Personal Plane, by R. H. Upson; *Aviation*, June-September, 1945, Vol. 44, No. 6, pp. 119–121; No. 7, pp. 145–148; No. 8, pp. 140–143; No. 9, pp. 128–132.

Design for Maintenance, by H. H. Steely; *Air Tech*, July, 1945, Vol. 7, No. 1, pp. 45, 62.

Style . . . Will Sell the Sky, by Richard Arbib; *Skyways*, July, 1945, Vol. 4, No. 7, pp. 45–48, 84.

The High Wing Monoplane for the Private Flyer, by R. G. Naugle; *Western Flying*, July, 1945, Vol. 25, No. 7, pp. 40–41, 76.

Wide Use of Magnesium Featured in New Spartan Executive '12'; *American Aviation*, July 15, 1945, Vol. 9, No. 4, p. 80.

Design for Safety, by J. P. Andrews; *Air News*, August, 1945, Vol. 9, No. 2, pp. 18–19.

Design Requirements; *Western Flying*, August, 1945, Vol. 25, No. 8, p. 37.

Variable-Load Design for Personal Airplane; *Southern Flight*, August, 1945, Vol. 24, No. 2, pp. 30–31.

Testing the Controllable [Spratt] **Wing;** *Aviation in Review*, August-September, 1945, Vol. 4, No. 4, pp. 3–8.

Designing Your Personal Air-Car, by Ed Yulke; *Science Digest*, September, 1945, Vol. 18, No. 3, pp. 23–26.

Toward Better Lightplane Performance; Low Wing Loading Means a Lightplane—but Present Polls Indicate Pilots Want Range, Payload, by Henri L. Portine; *Skyways*, September, 1945, Vol. 4, No. 9, pp. 48–50, 86, 88.

New 3-in-1 Pilot Control Invention [Elme] **Announced;** *American Aviation Daily*, September 27, 1945, Vol. 41, p. 128.

Elimination of Direct Reading Compass Errors by Proper Aircraft Design, paper presented by J. Manildi at Institute of Aeronautical Sciences Light Aircraft Meeting, Detroit, October 4, 1945.

Probable Materials of Construction—Post Reconversion Light Airplane, paper presented by F. B. Lane at Institute of Aeronautical Sciences Light Aircraft Meeting, Detroit, October 4, 1945.

A Unified Approach to Private Aircraft Design, paper presented by George H. Tweney at Institute of Aeronautical Sciences Light Aircraft Meeting, Detroit, October 4, 1945.

Control Operation of the Spratt Wing, paper presented by George Spratt at Institute of Aeronautical Sciences Light Aircraft Meeting, Detroit, October 5, 1945.

Simplified Design for Low-Cost Airplanes, paper presented by Alfred Marchev at Institute of Aeronautical Sciences Light Aircraft Meeting, Detroit, October 5, 1945.

Engines

Progress in Light Aircraft Engines, by C. F. Bachle; *SAE Journal* (Transactions), June, 1940, Vol. 46, No. 6, pp. 243–249.

Quantity Production of Small Radial Engines, by Gunnar Edenquist; *Aviation*, April, 1940, Vol. 39, No. 4, pp. 48–49, 115.

Bravo for Small Engines; *Flying Aces*, July, 1940, Vol. 35, No. 4, pp. 26–27.

Economic Aspects of Light Airplane Engines, by Carl T. Doman; *SAE Journal* (Transactions), July, 1940, Vol. 47, No. 1, pp. 284–290.

Geared Engines for Light Airplanes, by C. H. Wiegman; *SAE Journal* (Transactions), July, 1940, Vol. 47, No. 1, pp. 301–304.

Light Aero Engines of Europe—Present and Future, by D. R. Pobjoy; *Journal of the Aeronautical Sciences*, August, 1940, Vol. 7, No. 10, pp. 441–443.

American Small Engine Development; *Intava World*, December, 1940, Vol. 3, No. 3, pp. 32–35.

Some Present-day Problems in Light Airplane Engines, by Ralph S. White; preprint of paper at Society of Automotive Engineers meeting, Washington, D.C., March 13–14, 1941, 40 pp.

Possibilities of the Two-Stroke Cycle for Small Aircraft Engines, by A. R. Rogowski; *Journal of the Aeronautical Sciences*, April, 1941, Vol. 8, No. 6, pp. 230–235.

Light Aircraft Engine Developments, by Harold E. Morehouse; *Journal of the Aeronautical Sciences*, August, 1941, Vol. 8, No. 10, pp. 393–400.

Development Problems of Light Aircraft Engines, by Carl T. Doman; *Journal of the Aeronautical Sciences*, September, 1941, Vol. 8, No. 11, pp. 413–418.

Cooling Characteristics of Submerged Light Aircraft Engines, by H. H. Ellerbrock, Jr.; *SAE Journal* (Transactions), January, 1942, Vol. 50, pp. 7–14.

Current Problems in Light Airplane Engines, by Ralph S. White; *SAE Journal* (Transactions), April, 1942, Vol. 50, pp. 141–159.

Light Plane Engines and Their Fuel Problems, by Carl T. Doman; *SAE Journal* (Transactions), May, 1942, Vol. 50, pp. 188–195.

Less Power to Use, by W. T. Piper; *Skyways*, December, 1942, Vol. 4, No. 2, pp. 27, 29, 70–71.

More Power to You, by William B. Stout; *Skyways*, December, 1942, Vol. 1, No. 2, pp. 26, 28, 71.

Post-War Lightplane Engines, by R. E. Garlent; *Sportsman Pilot*, Mid-April, 1943, Vol. 29, No. 4, pp. 16–17.

What If the Engine Quits? [argument for two-engined personal planes] by B. P. Churchill; *Air Facts*, May, 1943, Vol. 6, No. 5, pp. 32–33, 36.

Difficulties with Engines Installed in Civil Aircraft, by Stephen H. Rolle; *Western Flying*, April, 1944, Vol. 24, No. 4, pp. 200–210.

Power Range Will Broaden, by Robert Insley; *Western Flying*, October, 1944, Vol. 24, No. 10, pp. 122–126.

Standardization and Price, by C. F. B. Roth; *Western Flying*, October, 1944, Vol. 24, No. 10, p. 126.

Ace in the Hole [Proposed Fuel System Design] by Leighton Collins; *Air Facts*, November, 1944, Vol. 7, No. 11, pp. 44–50.

Engines for Private Planes, by C. T. Doman; *Flying*, November, 1944, Vol. 35, No. 5, pp. 51–52, 106, 110.

One or Two Engines? [for private aircraft] by H. Piper; *Air Facts*, March, 1945, Vol. 8, No. 3, pp. 28–31.

American Aircraft Engines [including light engines]; *Western Flying*, April, 1945, Vol. 25, No. 4, pp. 127–158.

Quantity Sales to Determine If GM Produces 225 Hp. Two-Cycle Engine; *Aviation News*, April 2, 1945, Vol. 3, No. 10, p. 14.

Continental Engines; the "A" Series; *Aero Digest*, April 15, 1945, Vol. 49, No. 2, pp. 82–85, 196.

Jet Lightplanes? by Charles M. Fischer; *Flying*, June, 1945, Vol. 36, No. 6, pp. 31, 120, 123.

Two-Cycle Engine [Menasco] **Entering Market;** *Aviation News*, June 25, 1945, Vol. 3, No. 22, p. 9.

Small Ten Dollar Jet [Personal Plane] **Engine is New Production Challenge,** by Scholer Bangs; *Aviation News*, July 9, 1945, Vol. 3, No. 24, p. 10.

Motorless Lightplanes with Prop-jets; *Aviation News*, August 13, 1945, Vol. 4, No. 3, p. 16.

Design Changes and Careful Handling Sharpen [Light] **Aircraft Engine Performance** (abstract) by R. D. Hicks; *SAE Journal*, September, 1945, Vol. 53, No. 9, p. 27.

Your Lightplane Engine; These Basic Factors Govern the Production, Selection and Operation of Lightplane Engines, by Thomas Frame; *Skyways*, September, 1945, Vol. 4, No. 9, pp. 30–31, 94.

15¢ Hourly Fuel Cost Claimed for 125-hp. Air-cooled Diesel [Shaffer-Thabeld]; *Southern Flight*, September, 1945, Vol. 24, No. 3, p. 31.

GM Develops 200 Hp. Engine [designed for private aircraft]; Buick Studying Production; *American Aviation*, September 1, 1945, Vol. 9, No. 7, p. 20.

Pre-Vue of Your Post-War Franklin Engines [advertisement]; *Aero Digest*, September 15, 1945, Vol. 50, No. 4, p. 6.

Lightplane Engine Output Set by GM; *Aviation News*, September 30, 1945, Vol. 4, No. 7, p. 17.

Lightplane Power Increases Overshadow Design Changes, by Karl Hess; *Aviation News*, September 24, 1945, Vol. 4, No. 9, pp. 15–16.

Development of Lightplane Engines, by Douglas Rolfe; *Air Trails*, October, 1945, Vol. 25, No. 1, pp. 38–39.

Pick Your Plane Engine, by Ed Yulke; *Skyways*, October, 1945, Vol. 4, No. 10, pp. 32–33, 86, 88, 90.

Equipment

Ice-Free Carburetors for Lightplanes, by L. V. Kimball; *Aviation*, March, 1941, Vol. 40, No. 3, pp. 48, 122.

Design for a Castered Landing Gear, by C. D. Tucker; *Industrial Aviation*, September, 1944, Vol. 1, pp. 42–44.

CAA Research on Swivel Wheels May Revise Nationwide Port Plan, by Blaine Stubblefield; *Aviation News*, December 18, 1944, Vol. 2, No. 21, p. 16.

Power Package for Light Planes [Retractable Landing Gears]; *Western Flying*, May, 1945, Vol. 25, No. 5, pp. 52, 54.

Superchargers To Raise Power and Lower Cost of Lightplane Engines, by E. W. Wasselewski; *Aero Digest*, July 1, 1945, Vol. 50, No. 1, pp. 114–115, 164.

Cross-Wind Landing Gear; *Flying*, August, 1945, Vol. 37, No. 2, pp. 39, 130, 132.

Gasoline Combustion Heater Slated for Lightplane Usage; *Aviation News*, August 15, 1945, Vol. 4, No. 3, pp. 41–42.

Compatibility of Roadability and Landing Requirements in Aircraft Undercarriages, paper presented by Reinhardt M. Rosenberg at Institute of Aeronautical Sciences Light Aircraft Meeting, Detroit, October 5, 1945.

Helicopters

Traveling by Helicopter, by William B. Stout and Franklin M. Reck; *In their* Tomorrow We Fly, New York, 1943, pp. 53–67.

Helicopter Promises to Revolutionize U.S. Private Flying—Pogue; *American Aviation*, April 1, 1944, Vol. 7, No. 21, p. 46.

For Whom the Bell Toils [helicopter possibilities] by C. B. F. Macauley; *Mechaniz Illustrated*, August, 1944, Vol. 32, No. 4, pp. 39–41.

The Sixty-Four Hundred Dollar Question [Helicopter]; *Air News*, February, 1945, Vol. 8, No. 2, pp. 22–23.

For Private Ownership, by G. S. Macauley; *Skyways*, February, 1945, Vol. 4, No. 2, pp. 19–20, 60.

Hall L. Hibbard, Lockheed Engineer, Predicts Family Jet-'copter in Decade; *Civil Aeronautics Journal*, June 15, 1945, Vol. 6, p. 67.

First Roadable Helicopter Completed in Los Angeles, by Scholer Bangs; *Aviation News*, July 2, 1945, Vol. 3, No. 23, pp. 12, 14.

Propellers

Lightplane Prop Tests [signed] James A. Wales, Jr.; *Sportsman Pilot*, November, 1941, Vol. 26, No. 5, pp. 19, 38, 40.

Controllable Pitch Propellers for Light Airplanes [by] Walter E. Burnham; *Aero Digest*, March, 1942, Vol. 40, No. 3, pp. 224, 226, 228.

Controllable Propellers for Lightplanes, by Walter E. Burnham; *Flying*, December, 1942, Vol. 31, No. 6, pp. 58–60, 140-141.

Propeller Efficiency of a Light Plane, by H. D. Wood and W. R. Woodward; SAE preprint, April, 1944, 9 pp.

The "Aeromatic" Propeller Makes Its Debut, by Sydney H. Fedan; *Aero Digest*, May 1-15, 1944, Vol. 45, No. 3, pp. 70–73, 126, 128; No. 4, pp. 80–82, 84.

Power Range and Control, by David Bierman; *Western Flying*, October, 1944, Vol. 24, No. 10, pp. 132–134.

Cost Trend is Down, by E. L. Bruce; *Western Flying*, October, 1944, Vol. 24, No. 10, p. 136.

Standardization and Cost, by Bert M. Wallenstein; *Western Flying*, October, 1944, Vol. 24, No. 10, pp. 134, 136.

New Controllable Pitch Propeller [Annesley] **for Lightplanes in Production,** by Blaine Stubblefield; *Aviation News* October 30, 1944, Vol. 2, No. 14, pp. 16, 18.

Controllable Pitch Prop Tested for Use on Small Plane Motors; *Aviation News*, March 6, 1945, Vol. 1, No. 32, pp. 15–16.

Advantages of Variable-Pitch over Fixed-Pitch Propellers for Light Planes, by J. D. Waugh; *Automotive and Aviation Industries*, May 1, 1945, Vol. 92, No. 9, pp. 28–31.

Constant Speed Lightplane Propeller [Iso-Rev], by John B. Thomson; *Aero Digest*, August, 15, 1945, Vol. 50, No. 4, pp. 64–65, 104.

Lightplane Propeller Development, by John D. Waugh; *Industrial Aviation*, August-September, 1945, Vol. 3, No. 2, pp. 27–32, 101–102; No. 3, pp. 39–45, 89–92.

Radio and Instruments

Private Radio's Handcuffs, by Moulton Taylor; *Western Flying*, December, 1940, Vol. 20, No. 12, pp. 26–28.

Radio and the Private Flyer, by Charles J. Schauers; *Flying*, June, 1941, Vol. 28, No. 6, pp. 41–42, 103–104.

Private Pilots' Co-Pilot, by Robert Monroe; *Air Progress*, February, 1943, Vol. 2, No. 2, pp. 38, 64.

Radio and Post-War Private Flying, by Sydney Nesbitt; *Western Flying*, November, 1943, Vol. 23, No. 11, pp. 42–43, 102, 114, illus.

Selecting Radio for Post-War Airplanes, by W. P. Lear; *Air Pilot and Technician*, June, 1944, Vol. 31, pp. 4–6.

Let's Make Instruments Flight-Like, by Ken Lester; *Air Facts*, November, 1944, Vol. 7, No. 11, pp. 19–28.

What Kind of Instruments for the Personal Plane? *Aviation*, November, 1944, Vol. 43, No. 11, pp. 122–123, 305–306.

Radio Equipment for the Personal Plane, by William P. Lear; *Aero Digest*, November 15, 1944, Vol. 47, No. 4, pp. 56–57, 154.

I'll Fly with Radio Regardless . . . by Sydney Nesbitt; *Aviation Maintenance*, December, 1944, Vol. 3, No. 1, pp. 78–79, 154, 158, 164.

Make Way for Aircraft Radio, by Sydney Nesbitt; *Flying*, December, 1944, Vol. 35, No. 6, pp. 47, 138, 140.

Air Track; the Answer to the Private Pilot's Dream; *Aviation and Yachting*, January, 1945, Vol. 12, No. 8, p. 16.

Radios, Ground Controls Expected to Spur Private Flying Expansion; *Aviation News*, January 22, 1945, Vol. 2, pp. 40–41.

Radio and the Small Airport, by Sydney Nesbitt; *Airports*, February, 1945, Vol. 7, No. 2, pp. 40–41, 46.

Overlapping Radio Bands Pose Cost Problem to Private Flyers [according to William P. Lear]; *Aviation News*, March 26, 1945, Vol. 3, No. 9, p. 38.

Airport Pilot — or Cross-Country Cruiser [value of instruments], by Jack Andresen; *Air News*, April, 1945, Vol. 4, No. 4, pp. 26–27, 80, 82.

Postwar Radio Possibilities for the Private Pilot, by William P. Lear; *Southern Flight*, April, 1945, Vol. 23, No. 4, p. 31.

Prospects for Radio Aids, by Bill Green; *Southern Flight*, April, 1945, Vol. 23, No. 4, pp. 20, 64.

Suggested Standards for Private Aircraft Radio, by K. H. Stelle; *Southern Flight*, April, 1945, Vol. 23, pp. 30–32, 68.

Lear, Inc. Developing Automatic Pilot for Private Flyer; Radar, VHF Hailed [by W. P. Lear]; *American Aviation*, April 1, 1945, Vol. 8, No. 21, pp. 68–69.

A Low-Frequency Aircraft Transmitter for CAP; a Two-Band Light-Weight Unit for Small Aircraft, by George Peterson, Jr.; *QST*, May, 1945, Vol. 29, No. 5, pp. 40–43.

A Radio Manufacturer Looks Out in Front, by R. E. Samuelson; *Aero Digest*, June 15, 1945, pp. 74–75, 114.

Postwar Outlook for Aircraft Instruments [including private flying], by Esther H. Forbes; *Southern Flight*, June-August, 1945, Vol. 23, No. 6, pp. 34–35, 40; Vol. 24, No. 1, pp. 38–39, 60; No. 2, pp. 38–40.

Pilots' Instrument Preferences [Kollsman survey]; *Airports*, August, 1945, Vol. 8, No. 2, pp. 61–62.

The Personal Pilot on Instruments, by Bill Green; *Southern Flight*, August, 1945, Vol. 24, No. 2, pp. 62, 64.

Radio for Private Planes, by Robert E. Frasier; *Air World*, September, 1945, Vol. 3, No. 6, pp. 18–19, 57–58.

Radio; FCC and CAA Make Joint Study of Simpler Private Plane Rules; *National Aeronautics*, September, 1945, Vol. 23, No. 9, p. 43.

Flight Instruments and Light Plane Utility, by R. E. Gillmor; *Pegasus*, September, 1945, Vol. 6, No. 3, pp. 1–3.

Lightplane Instrument Era Forecast by Sperry Head [R. E. Gillmor]; *Aviation News*, September 3, 1945, Vol. 4, No. 6, p. 21.

Radio for Light Aircraft [signed] Douglas Deans; *Flight*, September 6, 1945, Vol. 48, p. 268.

Itinerant Aircraft Radio, paper presented by H. T. Sagert at Institute of Aeronautical Sciences Light Aircraft Meeting, Detroit, October 4, 1945.

Seaplanes

Light Seaplane Pointers, by Kenneth Baets; *Western Flying*, March, 1940, Vol. 20, No. 3, pp. 14–15.

Seaplaning is Fun! by Franklin T. Kurt; *Flying and Popular Aviation*, April, 1940, Vol. 26, No. 4, pp. 20–22, 64, 66.

Hints on Seaplane Operation, by Frederick H. Smith; *Aero Digest*, May, 1940, Vol. 36, No. 5, pp. 40–41, 79.

The Water's Fine! by Lawrence Ward; *Flying and Popular Aviation*, October, 1940, Vol. 27, No. 4, pp. 40–41, 89.

Seaplaning—Three Sports in One; *Popular Mechanics*, November, 1940, pp. 674–677, 141A.

Coast to Coast on Floats, by Wolfgang Langewiesche; *Air Facts*, December, 1940, Vol. 3, No. 12, pp. 9–19.

Water Preferred, by Howard Hasbrook; *Air Trails*, May, 1941, Vol. 16, No. 2, pp. 14–15, 52–53.

Seaplanes; *Air Facts*, August, 1941, Vol. 4, No. 8, pp. 9–17.

Water Flying for the Sportsman Pilot. *In* Water Flying on Edo Floats. College Point, N.Y., Edo Aircraft Corporation, 1943, pp. 3–4.

Thunderbolt Amphibian . . . Republic Reveals Plan for Post-War Amphibian; *Aviation Review*, November, 1944, Vol. 5, No. 11, pp. 11, 33.

Republic Develops Four Place Amphibian for Post-War Market, by Alexander McSurely; *Aviation News*, December 4, 1944, Vol. 2, No. 19, pp. 17–18.

Personal Planes [Republic Thunderbolt Amphibian], by C. J. Hawkins; *Air Tech*, January, 1945, Vol. 6, No. 1, p. 43.

Republic Reveals New . . . Postwar Private Amphibian . . . With Attractive Features; *Canadian Aviation*, January, 1945, Vol. 18, No. 1, p. 68.

Republic's Novel "Personal" Plane [Thunderbolt Amphibian]; *Commercial Aviation*, January, 1945, Vol. 6, No. 11, pp. 48, 50.

Republic Offers Postwar Personal Plane; *Skyways*, January, 1945, Vol. 4, No. 1, pp. 48–49.

Will a Lake Be Your Postwar Landing Field? *Popular Science*, February, 1945, Vol. 146, No. 2, pp. 134–135.

Pontoon Possibilities, by Eric Sloan; *Air News*, March, 1945, Vol. 4, No. 3, pp. 58–59.

Republic's 'Seabee' Undergoing Changes; *American Aviation*, June 1, 1945, Vol. 9, No. 1, pp. 78, 80.

Republic Seabee Wins Enthusiasm; *Aviation Review*, July, 1945, Vol. 6, No. 7, pp. 14, 23.

Plane Talk for Sportsmen; That Postwar Air Flivver You've Been Waiting for—Just What Sort Should You Buy, and What Can You Expect of It? by Henry S. Beverage; *Outdoor Life*, July, 1945, Vol. 96, No. 1, pp. 32–33, 78.

Year-Old Trimmer Amphibian Emerges As Market Challenge, by Karl Hess; *Aviation News*, August 20, 1945, Vol. 4, No. 4, p. 38.

Twin-Engine Amphibian [Commonwealth Aircraft] **for Low-Price Market;** *Southern Flight*, September, 1945, Vol. 24, No. 3, p. 37.

Announcing the "Trimmer" Amphibian [Commonwealth Aircraft]; *Aero Digest*, September 15, 1945, Vol. 50, No. 4, pp. 95, 104.

FLYING

Business Use

Business Airplane Survey [signed] Dwane L. Wallace; *Air Facts*, December, 1939, Vol. 2, No. 13, pp. 41–43.

"Dear Editor—" [use of airplane by patent attorney], by Robert F. Davis; *Southern Flight*, November, 1940, Vol. 14, No. 5, pp. 10–14.

Wings up the River, by Mervin Rosenbush; *Flying and Popular Aviation*, February, 1941, Vol. 28, No. 2, pp. 27–28.

Planes for Small-Town Papers, by George R. Reiss; *Flying and Popular Aviation*, May, 1941, Vol. 28, No. 5, p. 35.

Flyin' Sheep Salesman, by Clint Shirley; *Flying and Popular Aviation*, June, 1941, Vol. 28, No. 6, pp. 35–36, 94.

The Good Ship Emmanuel [missionary use of light plane], by H. D. Robards; *Flying and Popular Aviation*, August, 1941, Vol. 29, No. 2, pp. 51–52, 82.

A Salesman Recommends, by Peter Volid; *Sportsman Pilot*, August 15, 1941, Vol. 26, No. 2, pp. 28, 30.

Flying Rancher, by Howard Osborne; *Flying and Popular Aviation*, October, 1941, Vol. 29, No. 4, pp. 31–32, 82.

He Flies the Range, by Alma Heflin; *Flying and Popular Aviation*, December, 1941, Vol. 29, No. 6, pp. 47, 84, 88.

To Be or Not To Be [possible postwar use of privately-owned aircraft], by Leighton Collins; *Air Facts*, February 1, 1943, Vol. 6, No. 2, pp. 15–26.

Air Cargo by Jeep, by T. B. Roberts; *Southern Flight*, October, 1943, Vol. 20, No. 4, pp. 48, 50.

When the Farmer Flies. The Demands of Air-Minded Agriculture Will Mean Jobs for Planes and Pilots, by W. H. Allen; *National Aeronautics*, January, 1944, Vol. 22, No. 1, pp. 14, 56.

Farmers with Wings, by P. Prickett; *Aircraft Age*, February, 1944, Vol. 2, No. 3, pp. 18–19, 54.

Cargo Flying 643,907 Miles by Jeep; *Southern Flight*, February, 1944, Vol. 2, No. 2, pp. 28–29, 48.

Utility Believed Key to Growth of Private Plane Development; *American Aviation*, June 1, 1944, Vol. 18, No. 1, p. 48.

Farm Planes [survey of purchasers], by F. L. Whan; *Aviation News*, August 21, 1944, Vol. 2, No. 4, p. 30.

Working Wings, by A. Nicholson; *Country Gentleman*, October, 1944, Vol. 114, pp 11, 63–67.

Personal Planes for Personal Gain; *Air News*, February, 1945, Vol. 8, No. 2, pp. 32–34, 74.

Airplanes and the Country Newspaper, by W. C. Hearst; *Air Pilot and Technician*, February, 1945, Vol. 33, No. 2, pp. 16, 28–29.

We Zip for Business, by R. B. Kenty; *Southern Flight*, February, 1945, Vol. 23, No. 2, pp. 29–30.

Coast Flying Is "Strictly Buiness," by Milton C. Hill; *Western Flying*, February, 1945, Vol. 25, No. 2, pp. 40–41, 84.

Flying by Salesmen Executives Studied; *Aviation News*, February 12, 1945, Vol. 3, No. 3, pp. 19–20.

Target for Tomorrow [free lance aerial photography], by George Arnold; *Air Tech*, March, 1945, Vol. 6, No. 3, pp. 50–51, 65–66.

Putting the Light Plane to Work! Immediate Post-War Future of Private Flying Is of Vital Importance to Industry; *Aviation Review*, March, 1945, Vol. 6, No. 3, pp. 9, 16.

The Farmers They Fly High; Oklahoma's Flying Farmers, by Elizabeth Coulson; *Collier's*, March 24, 1945, Vol. 115, No. 12, pp. 21, 55.

I Am a Businessman, by Harold H. Lindblad; *Flying*, May, 1945, Vol. 36, No. 5, pp. 28–29, 128–130.

Switch to Flying for Business' Sake! by F. R. Gaylord; *Southern Flight*, June, 1945, Vol. 23, No. 6, pp. 30–31.

Washington [insurance] **Adjuster Finds Use of Airplane Practical and Economical,** by J. T. Dickson; *Weekly Underwriter*, June 16, 1945, Vol. 152, pp. 1412+.

Crop Dusting With a Cub; *Canadian Aviation*, July, 1945, Vol. 18, No. 7, pp. 50, 64.

Selling by Air—a Case History, by Reginald Snover; *Aero Digest*, July 15, 1945, Vol. 50, No. 2, pp. 78–79.

Cargo Carrying Lightplane Indicates New Sales Field, by Alexander McSurely; *Aviation News*, July 23, 1945, Vol. 3, No. 26, pp. 30–31.

More Utility for the Private Plane [farm use] by A. B. Bennett; *Airports*, August, 1945, Vol. 8, No. 2, p. 44.

Practical Purpose Flying; by Dick Brown; *Airports*, August, 1945, Vol. 8, No. 2, pp. 42–43.

Business Flights in Private Planes Save Executives' Time; *Scientific American*, August, 1945, Vol. 173, p. 104+.

"Flying Farmers" List Lightplane Uses; *Aviation News*, August 13, 1945, Vol. 4, No. 3, p. 42.

Flying Farmers; Oklahomans Use Small Planes to Speed Tasks Over Their Big Farms; *Life*, August 27, 1945, Vol. 19, No. 9, pp. 43–44, 46.

Built for Businessmen, by Hanford Eckman; *Air Trails*, September, 1945, Vol. 24, No. 6, pp. 34–35, 76, 80.

Wings at Work, by Jonathan Wood; *Air World*, September, 1945, Vol. 3, No. 6, pp. 13–14, 60.

More Sales by Plane, by E. W. "Pop" Cleveland; *Southern Flight*, September, 1945, Vol. 24, No. 3, pp. 34–35.

Oklahoma's Flying Farmers, by Viola Foster; *Southern Flight*, September, 1945, Vol. 24, No. 3, pp. 36, 60.

Farm Lightplanes Filling New Tasks; *Aviation News*, September 3, 1945, Vol. 4, No. 6, p. 25.

Crop Dusters from Cubs, by F. H. Ponish; *Aviation Maintenance*, October, 1945, Vol. 4, No. 5, pp. 54–56, 98.

Flying Movie Maker, by M. M. Winters; *Skyways*, November, 1945, Vol. 4, No. 11, pp. 22–23, 70.

Cost of Operation

Comparative Operating Cost of 2 Airplanes, 2 Automobiles and 1 Motor Boat; *Yankee Pilot*, February, 1940, Vol. 3, No. 2, p. 8.

The Cost of Owning and Operating Small Aircraft, by Cyrl W. Terry and Paul Kellogg; *Aviation*, April, 1941, Vol. 40, No. 4, pp. 34–35, 154, 156, 158.

How Expensive Is Flying? *Southern Flight*, January, 1944, Vol. 21, No. 1, pp. 38, 40.

We Zip for Business, by R. B. Kenty; *Southern Flight*, February, 1945, Vol. 23, pp. 29–30.

Under Present Regulations You Can't Afford Storage for Your Future Private Plane; *Canadian Aviation*, March, 1945, Vol. 18, No. 3, p. 60.

Thrift Contest: Jaloppy Vs. Plane, by Wayne Parrish; *Liberty*, March 31, 1945, Vol. 22, No. 13, p. 13.

Switch to Flying for Business' Sake! by F. R. Gaylord; *Southern Flight*, June, 1945, Vol. 23, No. 6, pp. 30–31.

High Operating Costs Seen Curbing Growth of Personal Flying [according to Aeronautical Training Society]; *Wall Street Journal*, June 1, 1945, Vol. 125, No. 128, p. 4.

Costs of Personal Flying, by R. H. Wood; *Aviation News*, June 18, 1945, Vol. 3, No. 21, p. 54.

Private Flying as a Budget Item [Aeronautical Training Society survey] by Wayne Parrish; *Liberty*, June 30, 1945, Vol. 22, No. 26, p. 13.

$90 Monthly Needed to Fly Own Plane; *American Aviation*, July 1, 1945, Vol. 9, No. 3, p. 48.

Selling by Air—a Case History, by Reginald Snover; *Aero Digest*, July 15, 1945, Vol. 50, No. 2, pp. 78–79.

Operating Cost Formulae for Personal Planes, by N. B. Berboth; *Pegasus*, August, 1945, Vol. 6, No. 2, pp. 13–16.

The Operating Costs of Personal Airplanes, by J. W. Friedlander; *Automotive and Aviation Industries*, August 1, 1945, Vol. 93, No. 3, p. 68.

Private Fliers' Operating Costs, by John W. Friedlander; *Airports*, September, 1945, Vol. 8, No. 3, pp. 58–59.

Peak Utility Needed to Meet Airplanes Operating Costs, by John W. Friedlander; *SAE Journal*, September, 1945, Vol. 53, No. 9, p. 25.

Average Cost of Storing Lightplane $15 a Month [according to Aeronautical Training Society survey]; *American Aviation*, September 1, 1945, Vol. 9, No. 7, p. 42.

Hangar Rent [$15 month average]; *Aviation News*, September 3, 1945, Vol. 4, No. 6, p. 21.

Flying Clubs

Flying for a Beer Pocketbook, by Alvah Bessie; *New Masses*, March 5, 1940, Vol. 34, No. 11, p. 17.

Birds of a Feather, by Edward Churchill; *Flying and Popular Aviation*, May, 1940, Vol. 26, No. 5, pp. 40–42, 72.

Cloud Club, by Tom R. Taylor; *Flying and Popular Aviation*, June, 1940, Vol. 26, No. 6, pp. 43, 90–91.

The Cub Flying Club Plan; *Aero Digest*, October, 1940, Vol. 37, No. 4, pp. 88, 90, 126.

So You Want to Start a Flying Club . . . by George R. Reiss; *Flying and Popular Aviation*, February, 1941, Vol. 28, No. 2, pp. 22–23, 66, 82–84.

Flying Stamps [account of Flying League of America], by Edward Clarke; *Flying and Popular Aviation*, March, 1941, Vol. 28, No. 3, pp. 38–39.

Flying for Everyone, by Wolfgang Langewiesche; *Western Flying*, March, 1941, Vol. 21, No. 3, pp. 22–24, 34.

Hornets' Nest, by Alma Heflin; *Flying and Popular Aviation*, April, 1941, Vol. 28, No. 4, pp. 35, 70, 72.

Five Men and a Plane, by Edward Churchill; *Flying and Popular Aviation*, May, 1941, Vol. 28, No. 5, pp. 26–27, 95–96.

Lend-Lease Pilots, by Leigh Culley; *Flying and Popular Aviation*, June, 1941, Vol. 28, No. 6, pp. 23, 84–85.

Flight Club, by Robert de Roos; *Flying and Popular Aviation*, July, 1941, Vol. 29, No. 1, pp. 50–52.

A Real Cooperative Club! by Ned Cody; *Flying Aces*, October, 1941, Vol. 39, No. 3, pp. 20–21.

A Flight Precedence System, by Russ Alexander; *Flying and Popular Aviation*, November, 1941, Vol. 29, No. 5, pp. 33, 104.

Hangar Flying [Flying Clubs]; *Sportsman Pilot*, December, 1941, Vol. 26, No. 6, pp. 22–23, 32–34.

Aviation Country Clubs Planned; *Aviation News*, April 10, 1944, Vol. 1, No. 37, p. 11.

Aviation Country Club Project Launched; *American Aviation*, May 1, 1944, Vol. 7, No. 23, p. 28.

Group Ownership of Lightplanes, by Vorras A. Elliott; *Aero Digest*, February 15, 1945, Vol. 48, pp. 54–55, 191, 193.

War Workers' Flying Club, by Lawrence Keil; *Flying*, April, 1945, Vol. 36, No. 4, pp. 26–27, 118, 120.

Navy Flying Club Members Enjoy Flying Taylorcrafts; *Taylorcraft News*, April-May, 1945, Vol. 6, p. 9.

Flying Country Club Style; *Air News*, May, 1945, Vol. 8, No. 5, pp. 28–30.

Start a Flying Club! [Signed] Ed Yulke; *Mechanix Illustrated*, July, 1945, Vol. 34, No. 3, pp. 45–47, 141.

Congressional Flying Club Gets Charter from NAA; *American Aviation*, July 15, 1945, Vol. 9, No. 3, p. 39.

Country Club for Flyers; *American Aviation*, July 15, 1945, Vol. 9, No. 3, p. 44.

Insurance

Brass Tacks [Life Insurance]; *Air Facts*, November, 1940, Vol. 3, No. 11, pp. 3–9.

What Insurance for the Private Owner? by Herbert W. Talbot; *Air Facts*, April, 1944, Vol. 7, No. 4, pp. 38, 40–41, 44–46.

Parks Offers New Plane Insurance Plan; *Aviation News*, October 23, 1944, Vol. 2, No. 3, p. 17.

Aviation [including private flying] **as a Postwar Problem,** by Richard T. Sexton; *Best's Insurance News*, December, 1944, Vol. 45, No. 8, pp. 15–16, 34.

Too Much for Too Little [private aircraft insurance], by George D. James; *Air Tech*, May, 1945, Vol. 6, No. 5, pp. 54, 57.

Better Aviation Insurance [including private flying]; *Western Flying*, June, 1945, Vol. 25, No. 6, p. 45.

Insurance Rates Unchanged Despite CAR 'Safety' Change; *Aviation News*, July 9, 1945, Vol. 3, No. 24, p. 40.

Insurance for AOPA Pilots; *Flying* (*AOPA News*), August, 1945, Vol. 37, No. 2, p. 76.

Personal Airplanes—Toys or Transportation; *Journal of American Insurance*, August, 1945, Vol. 22, No. 8, pp. 10, 24.

New Insurance Policy for Private Owners; *The Aeroplane*, August 3, 1945, Vol. 69, pp. 116–117.

Maintenance

The Care and Treatment of a Lightplane, by Harvey N. Martin; *Flying and Popular Aviation*, November, 1940, Vol. 27, No. 5, pp. 32–33, 52, 73.

Maintenance Development in Light Aircraft, by R. W. Rummel; preprint of paper for National Fuels and Lubricant Meeting, Society of Automotive Engineers, November 7, 1940, 10 pp.

Maintenance for the Private Owner, by Frank Say; *Aviation*, December, 1940, Vol. 39, No. 12, pp. 52–53, 126, 138.

Light Plane Maintenance, by Donald C. Dobbyn; *Aviation*, December, 1941, Vol. 40, No. 12, pp. 73, 216.

Lubricate Lightplanes Carefully, by Jack Morningstar; *Flying and Popular Aviation*, December, 1942, Vol. 31, No. 6, pp. 48, 132.

Make That Airplane Last, by J. H. Dressel; *Air Progress*, April, 1943, Vol. 2, No. 4, pp. 34, 64–65.

If Your Plane Has Been Stored, by Alma Heflin McCormick; *Flying*, September, 1943, Vol. 33, No. 3, pp. 72, 74.

Keeping the Light Plane Airworthy, by S. J. Stelle; *Aviation Maintenance*, December, 1943, Vol. 1, No. 1, pp. 73–78.

Cold Weather Plane Care; *Air Pilot and Technician*, January, 1944, Vol. 31, No. 1, pp. 19–20, 40.

Operator-Responsibilities Rule Air Future, by E. J. Foley; *American Aviation*, December 1, 1944, Vol. 8, No. 13, p. 76.

Procedure for Installing Landing Gear on Light Aircraft; *Aviation Maintenance*, March, 1945, Vol. 3, No. 4, pp. 57–64.

How to Install and Align Tail Surfaces on Light Planes; *Aviation Maintenance*, May, 1945, Vol. 3, No. 6, pp. 59–66.

New Responsibilities for Operators; *Aviation Maintenance*, August, 1945, Vol. 4, No. 3, p. 37.

Standardizing Repair Prices [Editorial]; *Aviation Maintenance*, October, 1945, Vol. 4, No. 5, p. 35.

Give Your Engine Longer Life, by Gilbert C. Close; *Flying*, October, 1945, Vol. 37, No. 4, pp. 44–45, 124, 126, 128.

Piloting

Lightplane Flying, by Wolfgang Langewiesche; New York, Chicago, Pitman Publishing Corporation, 1939, 213 pp.

Flying Stamps [plan for free flying lessons], by Edward Clarke; *Flying and Popular Aviation*, March, 1941, Vol. 28, No. 3, pp. 38–39.

Flying After Dark, by Bradley D. Pischel; *Western Flying*, August, 1941, Vol. 21, No. 8, pp. 26–27, 50.

What about the Night? by William D. Strohmeier; *Sportsman Pilot*, December, 1942, Vol. 28, No. 6, pp. 16–17, 43, 50.

Who Said Handicapped? by George R. Reiss; *Air Progress*, August, 1943, Vol. 3, No. 2, pp. 36–37, 61.

Personal Flying Previews, by R. H. Wood; *Aviation News*, February 7, 1944, Vol. 1, No. 28, p. 42.

Too Old to Fly? by Ken Lester; *Air Facts*, April, 1944, Vol. 7, No. 4, pp. 9–13.

. . . And a Child Shall Fly Them, by Irving Stone; *Aviation*, September, 1944, Vol. 43, No. 9, pp. 110–111, 279, 281–282.

Anyone Can Learn to Fly in 5 Hours; Parks' Tests with Ercoupe Show; *Aviation News*, September 4, 1944, Vol. 2, No. 6, p. 18.

We Need a Civilian Pilot Training Program, by Hon. Patrick A. McCarran; *Flying Aces*, December, 1944, Vol. 49, No. 1, pp. 10–12, 60–61.

Flying Country Club Style; *Air News*, May, 1945, Vol. 8, No. 5, pp. 27–30.

Training the Private Pilot, by Containe; *Aeronautics*, June, 1945, Vol. 12, No. 5, pp. 46–48.

For Flighty Vacationists! This Novel Plan Permits You to Holiday and to Learn to Fly Simultaneously; *Aviation Review*, June, 1945, Vol. 6, No. 6, p. 10.

Teaching Tomorrow's Private Fliers; *Airports*, July, 1945, Vol. 8, No. 1, pp. 58, 60.

Why Not Activate the CPTP? by Grove Webster; *Airports*, July, 1945, Vol. 8, No. 1, p. 55.

Wing Talk [Al Bennett says any child can fly a plane], by George R. Reiss; *Collier's*, July 14, 1945, Vol. 116, No. 1, p. 8.

Let Us Profit by War Training, by Grove Webster; *Airports*, August, 1945, Vol. 8, No. 2, p. 57.

Reconversion of a Pilot, by Wm. E. Cobb; *Air Facts*, August, 1945, Vol. 8, No. 8, pp. 34–37.

Flying Began at Fifty, by George V. Caesar; *Air Facts*, October, 1945, Vol. 8, No. 10, pp. 9–19.

Private Pilot . . . Plus, by W. W. Ward; *Air Facts*, October, 1945, Vol. 8, No. 10, pp. 33–42.

Flying Stamps [for free flight instruction]; *Flying*, October, 1945, Vol. 37, No. 3, pp. 69, 128, 130.

Purchasing

On the Light Plane Tarmac; *Flying Aces*, February, 1940, Vol. 34, No. 3, pp. 28–30, 80.

How to Buy an Airplane, by Charles Yerkow; *Flying Aces*, January, 1942, Vol. 40, No. 2, pp. 20–21, 80.

So You Are Going to Buy a Used Airplane, by Joe Chase; *Air Facts*, August, 1944, Vol. 7, No. 8, pp. 60–62, 64–66.

Easy does it [purchasing of plane], by Paul V. McNamara; *Air Facts*, January, 1945, Vol. 8, No. 1, pp. 52–58.

So You're Going to Buy a Used Airplane? by E. F. Lindsley; *Aviation*, January, 1945, Vol. 44, No. 1, pp. 193–194, 262–264.

Going to Buy a Plane? by Gilbert Paust; *Mechaniz Illustrated*, January, 1945, Vol. 33, No. 3, pp. 50–51.

Before I Buy a Plane; Traditionalism in Personal Planes and Discouraging Aviation Regulations, by J. H. Geisse; *Flying*, February, 1945, Vol. 36, No. 21, pp. 30–31, 98; see also *Science Digest*, April, 1945, Vol. 17, No. 4, pp. 59–64.

Buying a Plane? by William D. Strohmeier; *National Aeronautics*, May, 1945, Vol. 23, No. 3, pp. 19–20, 25.

Financing

Finance Your Flying, by De Witt Wendell; *Flying and Popular Aviation*, December, 1940, Vol. 27, No. 6, pp. 37, 76, 78–79.

Bankers Won't Bite, by Donn Hale Munson; *Yankee Pilot*, October, 1941, Vol. 4, No. 10, pp. 10–11.

Private Flying's Future Through Financial Eyes, by Gene Royer; *Southern Flight*, February, 1942, Vol. 17, No. 2, p. 37.

Planes for All; *Business Week*, June 12, 1943, No. 719, pp. 105–106.

Hundreds Join Cessna Post-War Plant Plan. Priority Delivery System for Family Air Cars Wins Customers; *Aviation News*, August 2, 1943, Vol. 1, No. 1, p. 21.

Financing of Aircraft Sales, by Stewart Linder; *Aero Digest*, November 15, 1944, Vol. 47, No. 4, pp. 80–81, 247.

Financing—and the Sale of Private Planes, by Harry A. Schaffer; *Airports*, January, 1945, Vol. 7, No. 1, pp. 44, 46.

Bank Credit Plan Favored to Finance New Plane Purchases; *Aviation News*, February 12, 1945, Vol. 3, No. 3, p. 43.

Offer New Finance Plan for Plane Parts and Repairs; *Aviation*, March, 1945, Vol. 44, No. 3, p. 171.

Lockheed Unit [Pacific Finance Corp.] **Lays Ground for Post-War Financing Service,** by Scholer Bangs; *Aviation News*, March 19, 1945, Vol. 3, No. 8, pp. 30–31.

Local Bank Displays Taylorcraft; Plans to Finance Airplanes; *Taylorcraft News*, April-May, 1945, Vol. 6, p. 5.

How to Finance Aircraft Sales Explained in New A.B.A. Manual; *Contact*, April 26, 1945, Vol. 9, No. 1, p. 7.

Banks Opening Books to Personal Plane Financing, by Raymond L. Hoadley; *Aviation*, September, 1945, Vol. 44, No. 9, pp. 189, 237, 241–242.

Civilian Planes to Be Sold on Installments, by H. Eugene Deck; *New York Herald Tribune*, September 16, 1945, Sec. II, Pt. 2, p. 1.

Financing Your Plane, by Lawrence Keil; *Flying*, October, 1945, Vol. 37, No. 4, pp. 48, 100, 102, 106.

Potential Lightplane Sale Bar Seen in Financing Limitations, by William Kroger; *Aviation News*, October 8, 1945, Vol. 4, No. 11, pp. 31–32.

Rental Service

Cross-Country Rentals; *Air Facts*, March, 1940, Vol. 3, No. 3, pp. 7–9.

Ailor-Fly-Ur-Self System, Inc.; *Air Facts*, June, 1940, Vol. 3, No. 6, pp. 12–14.

Post-War Fly-It-Yourself Service Envisioned; *Air Pilot and Technician*, March, 1944, Vol. 31, No. 3, pp. 14–15.

"Drivurselfs" Eye Plane Rental Field; *Aviation News*, May 22, 1944, Vol. 1, No. 43, p. 17.

Fly-Yourself Is Big Business, by Howard Ailor; *Aviation*, June, 1944, Vol. 43, No. 6, pp. 184, 297.

Post War "Fly-It-Yourself!" by Ralph Powers; *Flying Aces*, June, 1944, Vol. 47, No. 3, pp. 34–35.

Fly-It-Yourself, by R. S. Robie; *Canadian Aviation*, July, 1944, Vol. 17, No. 7, pp. 40–43.

Port Operators Study Progress of Rent-a-Plane, Air Taxi Project, by Alexander McSurely; *Aviation News*, September 18, 1944, Vol. 2, No. 8, p. 14.

New Business for the Fixed Base Operator "Fly-Ur-Self"; *Airports*, March, 1945, Vol. 7, No. 3, pp. 47, 55.

National Rental Plane Network Planned for One-Way Flights, by Alexander McSurely; *Aviation News*, July 9, 1945, Vol. 3, No. 24, pp. 34, 36.

Safety

Tom Hardin Calls for Spinproof Planes As Essential Safety Aids; *American Aviation*, March 15, 1940, Vol. 3, No. 20, pp. 1, 10.

For a Ripe Old Age—Follow the Flying Rules, by Tom Hardin; *Aviation*, May, 1940, Vol. 39, No. 5, pp. 42–43, 110.

Safe as You Make It, by Alma Heflin; *Air Trails*, July, 1940, Vol. 14, No. 4, pp. 25, 58–59.

Miraculous Safety, by Hugh de Haven; *Air Facts*, March, 1941, Vol. 4, No. 3, pp. 21–26.

Safety in Private Flying, by Bill Green; *Southern Flight*, May, 1941, Vol. 15, No. 5, p. 14.

Instruction Problems; Various Angles Discussed by an Operator, Instructor, Student and Insurance Representative; papers at National Safety Council Convention, New York; *Sportsman Pilot*, May 15, 1941, Vol. 25, No. 5, pp. 12–15, 32–40.

New Fields for Safety; *Air Facts*, July, 1941, Vol. 4, No. 7, pp. 5–8.

Is Your Flying Safe? by James L. H. Peck; *Flying and Popular Aviation*, July, 1941, Vol. 29, No. 1, pp. 27–28, 96.

How Safe Is Your Plane? by Dwight Sevain; *Flying and Popular Aviation*, August, 1941, Vol. 29, No. 2, pp. 35–36, 88, 90, 92.

Keep Your Lightplane Airworthy, by J. H. Dressel; *Flying*, February, 1942, Vol. 30, No. 2, pp. 31–32, 90, 94.

Load Factors Obtained in Civil Airplanes in Acrobatic Maneuvers, by E. I. Ryder; *Journal of the Aeronautical Sciences*, April, 1942, Vol. 9, No. 6, pp. 195–201.

Causes of Injury in Lightplane Accidents, by Hugh de Haven; *Aero Digest*, March 1, 1944, Vol. 44, No. 5, pp. 51–55, 206.

Make Planes Safe; Don't Rely on Pilot's Skill—Geisse; *American Aviation*, May 1, 1944, Vol. 7, No. 23, p. 22.

Development of Stall Warning Indicators, by James George; *Aeronautical Engineering Review*, June, 1944, Vol. 3, No. 6, pp. 41–55.

The Older the Safer, by William D. Strohmeier; *Air Facts*, February, 1945, Vol. 8, No. 2, pp. 32–37.

Safer Private Airplanes at Less Cost, by G. E. Otter; *Aero Digest*, March 15, 1945, Vol. 48, No. 6, pp. 72–73, 203, 205.

Spin-Resistant Models Studied for Post-War Private Plane Market; *Aviation News*, January 17, 1944, Vol. 1, No. 25, p. 24.

Design Features Make Plane Safe [abstract], by F. E. Weick; *SAE Journal*, May, 1945, Vol. 53, No. 5, p. 36.

Suggested Standards for Safer Airplanes, by Raymond B. Maloy; *Southern Flight*, May, 1945, Vol. 23, No. 5, pp. 40, 66, 68.

A Résumé of Desirable Characteristics for Non-Stalling Non-Spinning Airplanes, paper by Raymond B. Maloy before Society of Automotive Engineers, Detroit, May 7, 1945, 10 pp.

Lightplane Spin-Stall Accident Halt Sought by CAA [Raymond B. Maloy] **Proposals;** *Aviation News*, May 14, 1945, Vol. 3, No. 16, p. 50.

Light Plane Maker Ready to Produce Safe, Easy-Handling, Economical Craft; *American Aviation*, May 15, 1945, Vol. 8, No. 24, p. 81.

Safe Utility Plane Will Stay Sold Geisse Tells Light Aircraft Makers; *Civil Aeronautics Journal*, May 15, 1944, Vol. 5, pp. 56–57.

V-S Day [discussion of safety in private flying], by Leighton Collins; *Air Facts*, June, 1945, Vol. 8, No. 6, pp. 11–20.

Challenge for Safety to Private Flying, by John H. Geisse; *Southern Flight*, June, 1945, Vol. 23, No. 6, pp. 32, 40.

Better Lightplanes for Tomorrow, by T. Bowring Woodbury; *Aero Digest*, July 15, 1945, Vol. 50, No. 2, p. 48.

Wing Talk [discussion of aircraft accidents], by Frederick R. Neely; *Collier's*, July 21, 1945, Vol. 116, No. 3, p. 8.

Design for Safety [CAB Analysis of Small-Plane Accidents], by John Paul Andrews; *Air News*, August, 1945, Vol. 9, No. 2, pp. 17–19.

Warning Sounded on Wire Collisions [by CAB Safety Bureau]; *Aviation News*, September 30, 1945, Vol. 4, No. 7, p. 16.

Summary of Structural Failures and Defects on Light Aircraft, paper presented by Burdell L. Springer at Institute of Aeronautical Sciences Light Aircraft Meeting, Detroit, October 4, 1945.

Surplus and Used Aircraft

We Buy a Used Plane, by Jack Rowley; *Flying and Popular Aviation*, March, 1941, Vol. 28, No. 3, pp. 29–30.

A Plan for Today's Aircraft Tomorrow, by Al Hansen; *Western Flying*, January, 1944, Vol. 24, No. 1, pp. 48, 98, 120.

OPA Announces Price Ceilings for Used Planes, 500 Hp. or Less; *Aviation News*, January 10, 1944, Vol. 1, No. 24, p. 14.

Nearly 1,000 Lightplanes for Sale, by Blaine Stubblefield; *Aviation News*, February 21, 1944, Vol. 1, No. 30, pp. 14–15.

500 More Surplus WTS Planes Swell Number to Be Sold to 1,500, by Blaine Stubblefield; *Aviation News*, February 28, 1944, Vol. 1, No. 31, p. 13.

Thousands of Small Planes Will Be Sold by Government; *American Aviation*, July 1, 1944, Vol. 8, No. 3, p. 82.

Look before You Buy a War Surplus Airplane; *Aviation Maintenance*, October, 1944, Vol. 2, No. 5, pp. 46–47, 178–184.

Want a Warplane? *Flying*, November, 1944, Vol. 35, No. 6, p. 75.

Converting Light Military Planes for Personal Use, by J. P. Lysdale; *Aviation Maintenance*, December, 1944, Vol. 3, No. 1, pp. 56–57.

How to Buy a Used Airplane, by Galen O. Gilbert; Terrell, Texas, Terrell Aviation Ltd., 1945, 12 pp.

Surplus Aircraft Market; an Analysis of the CAA Sale of Surplus Planes. Washington, D.C., Civil Aeronautics Administration, 1945, 20 pp.

The Problem of Surplus Planes, by James Ellis; *Flying Aces*, January, 1945, Vol. 49, No. 2, pp. 40–41, 46–47.

Going! Going! Gone, by Tom Alexander; *Air Pilot and Technician*, March, 1945, Vol. 33, No. 3, pp. 22–23, 31.

Used or Misused? *Air Tech*, March, 1945, Vol. 6, No. 3, pp. 24–26.

RFC Surplus Plane Ads Threaten Damage to Private Flying Future, by Alexander McSurely; *Aviation News*, April 9, 1945, Vol. 3, No. 11, pp. 17–18.

RFC Disposal of Surplus Planes Denounced by CAA Committee; *American Aviation*, April 15, 1945, Vol. 8, No. 22, pp. 42–43.

RFC Discontinues Criticized Ads Seeking Buyers for Surplus Trainers, by Alexander McSurely; *Aviation News*, April 16, 1945, Vol. 3, No. 12, pp. 15–16.

For Sale . . . Used Lightplanes, by Henri L. Portine; *Skyways*, May, 1945, Vol. 4, No. 5, pp. 28–31, 70, 72, 82.

Production Prospects; Cessna LC-78 Conversion, by George E. Haddaway; *Southern Flight*, May, 1945, Vol. 23, No. 5, pp. 29–31, 70.

The Dilemma of Too Much—Too Soon, by George Stromme; *Western Flying*, May, 1945, Vol. 25, No. 5, pp. 40–41, 70–75.

Salvaging War Surplus Aircraft for Post-War Civilian Use, by Russ Brinkley; *Aero Digest*, June 15, 1945, Vol. 49, No. 6, pp.42–43, 209–210.

Mass Plane Market Starts with Surplus, by John Foster, Jr.; *Aviation*, July, 1945, Vol. 44, No. 7, pp. 118–120.

Buying That Used Plane, by J. Llewellyn Clark; *Flying*, August, 1945, Vol. 37, No. 2, pp. 55–57, 114, 118, 120, 122.

Buy 'Em and Fly 'Em . . . Maybe! by Byrd Howell Granger; *Air Facts*, August 1, 1945, Vol. 8, No. 8, pp. 24–32.

Factors in Used Plane Appraisal, by Anthony L. Jacobs; *Aero Digest*, August 15, 1945, Vol. 50, No. 4, pp. 40–41, 129–130.

Reconditioning of Surplus Trainers, by William L. Blythe; *Aero Digest*, August, 15, 1945, Vol. 50, No. 4, pp. 69–70, 134.

Accounting for Used Aircraft, by Todd Mumma; *Aviation Maintenance*, September, 1945, Vol. 4, No. 4, pp. 47–49.

P-38 Purchased as Personal Plane, by Karl Hess; *Aviation News*, September 17, 1945, Vol. 4, No. 8, pp. 16–17.

Touring

I'll Take the High Road, by Wolfgang Langewiesche; New York, Harcourt, Brace and Co., 1939, 254 pp.

Contact—It's Spring! Calling All Light Planes, by Alma Heflin; *Air Trails*, May, 1940, Vol. 14, No. 2, pp. 30, 44, 46.

An Aerial Holiday, by Chet Chenoweth; *Western Flying*, June, 1940, Vol. 20, No. 6, pp. 21–22.

Air Camping is Sport! by Wolfgang Langewiesche; *Flying and Popular Aviation*, December, 1940, Vol. 27, No. 6, pp. 14–16, 66.

So You're Going Cross-Country, by Robert W. Crawford; *Sportsman Pilot*, January 15, 1941, Vol. 25, No. 1, pp. 10, 40, 42.

Sky-Touring in Canada, by James Montagne; *Flying and Popular Aviation*, July, 1941, Vol. 29, No. 1, pp, 48, 92.

Pilot—Stray Not Into Mexico, by Ralph H. Miner; *Flying and Popular Aviation*, August, 1941, Vol. 29, No. 2, pp. 30–31, 74.

Your First Cross-Country, by Wolfgang Langewiesche; *Air Facts*, September, 1941, Vol. 4, No. 9, pp. 23–41.

Fly North, Pilot, by Herbert L. White; *Flying and Popular Aviation*, November, 1941, Vol. 29, No. 5, pp. 57, 74, 104.

Three Flag Vacation, by Evelyn N. Burleson; *Western Flying*, November, 1941, Vol. 21, No. 11, pp. 50, 60, 62.

Sky Camps [observations on the possible effect of the growth of the use of the small plane upon the development of recreational areas and facilities]; Lansing, Michigan State Planning Commission, 1943, 16 pp.

Tomorrow's Vacation [Michigan's Plan for Sky Camps], by Paul Andrews; *Air News*, August 15, 1943, Vol. 5, No. 2, pp. 16–17.

Are We Afraid of Cross Country? by William D. Strohmeier; *Air Facts*, May, 1944, Vol. 7, No. 5, pp. 21–26.

Piloting—Navigation for Light Planes; *Aviation and Yachting*, October, 1944, Vol. 12, No. 5, p. 8.

I'll Get in My Little Plane and Zip! by Wesley Price; *Saturday Evening Post*, October 7, 1944, Vol. 217, No. 15, pp. 9–11, 70.

West Southwest, by Leighton Collins; *Air Facts*, December, 1944, Vol. 7, No. 12, pp. 58–85.

Prewar Plane + War Conditions Do Not = Postwar Flying; SatEvePost Reporter Price Stabs Postwar Flying With Prewar Plane and Wartime Conditions, by John R. West; *Skyways*, January, 1945, Vol. 4, No. 1, pp. 33, 70, 75.

Couple Get into a Little Plane and Zip 1514 Miles, by Dorothy and Robert Blodget; *American Aviation*, February 1, 1945, Vol. 8, No. 17, p. 48.

So What If It Won't "Zip," by F. L. Harvey; *Air Facts*, May, 1945, Vol. 8, No. 5, pp. 41–47.

Wide Use of Planes for 100-Mile-Plus Journeys Predicted by Burden; *Civil Aeronautics Journal*, May 15, 1945, Vol. 6, pp. 49–50, 59.

What, No Zip, Mr. Price? by Sandy A. F. MacDonald; *Aviation Review*, June, 1945, Vol. 6, No. 6, pp. 9, 24–25.

3,000-Mile Zip, by J. P. Ryan; *Western Flying*, July, 1945, Vol. 25, No. 7, pp. 47, 70.

A Flying Vacation, by Devon Francis; *Popular Science*, August-September, 1945, Vol. 147, No. 2, pp. 54–57, 202, 206, 210; No. 3, pp. 131–135, 207.

6,000 Miles by Lightplane, by Ruth Ballard; *Western Flying*, August, 1945, Vol. 25, No. 8, pp. 32, 54.

Lightplane Trip, by Devon Francis; *National Aeronautics*, August-September, 1945, Vol. 23, No. 8, pp. 11–12, 26; No. 9, pp. 11–12, 26.

Skycamps for Tomorrow's Vacation, by John Paul Andrews; *Science Digest*, October, 1945, Vol. 18, No. 4, pp. 25–28. *From his* Your Personal Plane, New York, 1945.

Women

The Gals Are Flying, by George R. Reiss; *Flying and Popular Aviation*, March, 1940, Vol. 26, No. 3, pp. 46–48.

I Let My Daughter Fly, by Mae Ash, ed. by Jerome Beatty; *American Magazine*, September, 1940, Vol. 130, No. 3, pp. 32–33.

Women Can Fly, by John R. Hoyt; *Flying and Popular Aviation*, November, 1941, Vol. 29, No. 5, pp. 22–24, 108.

Woman's Angle; *National Aeronautics*, December, 1944, Vol. 22, No. 12, p. 30.

A Letter to Santa [women aircraft purchasers], by Mimi Cerlian; *Air Facts*, January, 1945, Vol. 8, No. 1, pp. 20–22.

Family Plane to Reflect Woman's Needs, by Sally Knapp; *Pegasus*, February, 1945, Vol. 5, No. 2, pp. 12–16.

What Woman Wants in Post-War Plane; *Aviation News*, February 26, 1945, Vol. 3, No. 5, p. 37.

The [Purchasing] **Power of a Woman;** *Air Tech*, March, 1945, Vol. 6, No. 3, pp. 31–34.

Five Hours to Solo, by Mary Merryfield; *Woman's Home Companion*, March, 1945, Vol. 72, No. 3, pp. 20, 60.

A Woman Looks at the Airplane, by E. Rae Rambeau; *Western Flying*, May, 1945, Vol. 25, No. 5, pp. 42–43.

FLYING FACILITIES

Aircraft Sales and Service

Getting Them into the Air! by Norman Warren; *Western Flying*, May, 1940, Vol. 20, No. 5, pp. 20–21, 28.

Why Not Try Super Service, by Charles T. Wrightson; *Western Flying*, August, 1940, Vol. 20, No. 8, pp. 17–19, 30.

We Pilots Want Service! by Edward Churchill; *Flying*, October, 1941, Vol. 29, No. 4, pp. 21–22, 88.

Object Lesson, by Ken Berglund; *Western Flying*, December, 1941, Vol. 21, No. 12, pp. 29–30.

Service for Tomorrow, by Edward Churchill; Webb du Von Isn't Waiting for the Post-War Boom in Flying; He Is Preparing Now for the Airman Who Is Tomorrow's Sportsman; *Flying*, March, 1943, Vol. 32, No. 3, pp. 87–88, 136.

Postwar Plan for Airplane Service; *Southern Flight*, December, 1943, Vol. 20, No. 6, p. 65.

Parks Aircraft Sales and Service; Aviation Educator Is Putting into Effect a Comprehensive Program for Serving Post-War Requirements of Private Flying, by W. D. Harris; *Aviation Maintenance*, October, 1944, Vol. 2, No. 5, pp. 37–45.

Competition of Oil Firms May Aid in Lightplane Facilities Expansion, by Alexander McSurely; *Aviation News*, November 6, 1944, Vol. 2, No. 15, p. 17.

We Must Sell Private Flying, by B. M. Towle; *Air Facts*, December, 1944, Vol. 7, No. 12, pp. 9–13.

Personal Planes [service] by R. C. Oertel; *Air Tech*, December, 1944, Vol. 5, No. 6, pp. 28, 72.

Today's Laws Will Make or Break Tomorrow's Airports, by John H. Wilson; *Airports*, December, 1944, Vol. 6, No. 12, p. 22.

Aviation's Expanding Opportunities for Individual Enterprise, by Arthur W. D. Harris; *Aviation Maintenance*, December, 1944, Vol. 3, No. 1, p. 39.

Private Flying and the Fixed Base Operator; Beverly Howard Plans to Streamline His Fixed-Base Operations, But Sees No Revolutionary Change for Future, by Fred Hamlin; *Flying*, December, 1944, Vol. 35, No. 6, pp. 23, 109–110.

Private Flying and the Fixed Base Operator; President of Parks Air College Says an Entirely New Concept of Private Flying Must Prevail for Mass Appeal, by Oliver L. Parks; *Flying*, December, 1944, Vol. 35, No. 6, pp. 22, 110, 114.

A Student's Lament, by Jay Russell; *Air Pilot and Technician*, January, 1945, Vol. 33, No. 1, pp. 10–11, 34.

Analyzing the Personal Plane Market, by Joseph T. Geuting, Jr.; *Airports*, January, 1945, Vol. 7, No. 1, p. 27.

Service Builds Sales, by Sydney Nesbitt; *Airports*, January, 1945, Vol. 7, No. 1, pp. 32, 50–51.

New Coast Group Maps Program of Merchandising Private Flying, by Scholer Bangs; *Aviation News*, January 22, 1945, Vol. 2, No. 26, p. 15.

Service Will Sell the Personal Plane, by E. Cody Laird; *Aviation Maintenance*, February, 1945, Vol. 3, No. 3, p. 46.

Place of the Fixed Base Operator in Aviation after the War, by Richard E. Posthauer; *Aero Digest*, March 1, 1945, Vol. 48, No. 5, pp. 54–55, 159.

Fixed Base Operations—Key to Aviation's Growth, by Dick Brown; *Airports*, April, 1945, Vol. 7, No. 4, p. 26.

A Major Source of Revenue; *Airports*, April, 1945, Vol. 7, No. 4, p. 19.

Airport Planning in Black Hills, by Howard Mehr; *Aviation Maintenance*, April, 1945, Vol. 3, No. 5, p. 98.

Service Stations of the Air . . . by I. W. Baldwin; *Aviation Review*, April, 1945, Vol. 6, No. 4, pp. 12–13, 30.

Money by Moonlight [night flying], by W. W. Ward; *Air Facts*, May, 1945, Vol. 8, No. 5, pp. 11–14.

Sales and Service, No. 1 Job Opportunity in Private Flying, by Norman Carlisle; *Air World*, July, 1945, Vol. 3, No. 5, pp. 16, 47.

Service Field Offers Great Opportunities, Says Balfour; *American Aviation*, August 1, 1945, Vol. 9, No. 5, p. 45.

Super-Service Stations . . . Add an Airstrip and the Roadside Gas Station Can Take Care of Your Plane, Too, by Harry Hemler; *Skyways*, September, 1945, Vol. 4, No. 9, pp. 22–23, 92.

Poor Airport Service, by Bill Green; *Southern Flight*, September, 1945, Vol. 24, No. 3, pp. 64, 66.

Airpark Buildings

Skyways Presents the Skytel. Stop-Off Points on Country's Highways Greet Postwar Pilots; *Skyways*, November, 1943, Vol. 2, No. 11, pp. 24–25.

The Case for the Hungry Pilots, by George Reiss; *Flying*, May, 1945, Vol. 36, No. 5, pp. 51, 112.

Cross Country Sky Comfort [Air-O-Tels], by Arnold B. Romney; *Air News*, July, 1945, Vol. 9, No. 1, pp. 52–53.

Park's Airpark Inn Is 'in' with Pilots; *Aviation News*, August 6, 1945, Vol. 4, No. 2, p. 44.

Building the Small Airport; Part VII A. Buildings, by Marc Thompson; *Aviation Maintenance*, September, 1945, Vol. 4, No. 4, pp. 50–53, 105–116.

Airparks

High-Flyin' Hector, by Joseph W. Morgan; *Flying*, February, 1941, Vol. 28, No. 2, pp. 32–34, 87–88.

Sky Camps [Discussion of future needs of recreational airports]; Lansing, Mich., Michigan State Planning Commission, 1943, 15 pp.

Airplane for Everybody; Backyard Airports Will Be As Common As Garages after the War, by Robert S. Kleckner; *Facts*, August, 1943, Vol. 3, No. 2, pp. 36–40.

Where Are You Going to Put It? [Airports for postwar private planes] by William Flynn; *Air Facts*, October, 1943, Vol. 6, No. 10, pp. 9–16.

Airparks for Tomorrow, by Don Forbes; *Western Flying*, February, 1944, Vol. 24, No. 2, pp. 52–53.

"Main Street" in the Coming Air Age [need for landing areas], by William T. Piper; *Aero Digest*, February 15, 1944, Vol. 44, No. 4, pp. 88–89.

Flying Utility and Economy, by Robert H. Wood; *Aviation News*, February 21, 1944, Vol. 1, No. 30, p. 46.

Landing Strips Can Pay Their Way . . . , by Russ Brinkley; *Air Pilot and Technician*, April, 1944, Vol. 31, No. 4, pp. 12–13, 35.

25,000 Landing Fields? by C. E. Planck; *Southern Flight*, April, 1944, Vol. 21, No. 4, pp. 30–31.

Airports—Resort—New Business; *Aviation*, May, 1944, Vol. 43, No. 5, pp. 190–191.

Airport Requirements of Private Flying, by J. M. Hagen; *Commercial Aviation*, May, 1944, Vol. 6, No. 5, pp. 36–37.

Why We Need 20,000 Air Strips, by William Mara; *Plane Talk*, May, 1944, Vol. 2, No. 3, pp. 4–6.

Wichita Aviation Men Launch Drive for City Landing Parks; *Aviation News*, May 15, 1944, Vol. 1. No. 42, pp. 17–18.

Port Plans Stress Needs of Private Flying Groups, by Blaine Stubblefield; *Aviation News*, June 26, 1944, Vol. 1, No. 48, pp. 16, 18.

Performance Characteristics of Postwar Personal Aircraft and Their Influence on Landing Facility Development, by Joseph T. Geuting, Jr.; *In* Joint Airport Users Conference, Washington, D.C., July 24–25, 1944. *Proceedings*, pp. 48–55.

Eastern Small Port Problems Studied by CAA Planning Groups; *Aviation News*, August 21, 1944, Vol. 2, No. 4, p. 30.

A Landing Facility in Every Community, by John E. P. Morgan; *Airports*, September, 1944, Vol. 6, No. 3, pp. 18–19.

Aero Civic Centers for All Towns of 1000 Population; *The Southernaire*, October, 1944, Vol. 2, No. 10, p. 10.

So You Want to Build an Airpark? by Eugene V. Fryhoff; *Airports*, November, 1944, Vol. 6, No. 5, p. 16.

Turf Can Pave the Way; *Airports*, November, 1944, Vol. 6, No. 5, pp. 22–23.

Air Fields for Farmers Pay, by John M. Hagen; *Airports*, December, 1944, Vol. 6, No. 6, pp. 19, 49.

Building the Small Airport, by Robert C. Blatt; *Aviation Maintenance*, December, 1944, Vol. 3, No. 1, pp. 59–61, 161; January, 1945, No. 2, pp. 48–51, 110–116; February, 1945, No. 3 pp. 50–53, 100–102.

Sky Ranch for Private Fliers, by Preston Doerfler; *Southern Flight*, December, 1944, Vol. 22, No. 6, pp. 55, 67.

4975 Ports Planned for Private Flyers [proposed CAA airport plan]; *Aviation News*, December 4, 1944, Vol. 2, No. 19, p. 10.

The Airplane Industry's Part in Airport Development, by James L. Straight, at California Aviation Conference, Los Angeles, December 12–13, 1944.

Facilities for Private Flying, by Lowell Swenson; *In* Digest of prepared papers, First California Aviation Conference, Los Angeles, December 12–13, 1944, 6 pp.

What Your Town Needs for the Coming Air Age, by William T. Piper; Lock Haven, Pa., Piper Aircraft Corporation, 1944, 35 pp.

An Airport for Your Community, by Donald J. Heng; Minneapolis, The Pure Oil Company, 1945, 21 pp.

Small Airports, prepared by Civil Aeronautics Administration; Washington, D.C., U.S. Govt. Print. Off., 1945, 30 pp.

Air Parks, by Oliver L. Parks; *Air World*, January, 1945, Vol. 3, No. 2, pp. 26–27, 54, 56.

How We Got Our Airpark [Redmond, Oregon], by M. E. Brown; *Plane Talk*, January, 1945, Vol. 3, No. 1, pp. 14–15.

E. B. McGurk, Inc., Completes Modern Private Airport At East Hartford; *Roads and Streets*, January, 1945, Vol. 88, No. 1, p. 85.

Aid for Private Airports; *Aviation News*, January 22, 1945, Vol. 2, No. 26, p. 38.

CAA Booklet Gives Airharbor Plans; *Aviation News*, January 22, 1945, Vol. 2, No. 26, p. 37.

Five New Airparks; *Aviation News*, January 22, 1945, Vol. 2, No. 26, p. 38.

Port Accounting; *Aviation News*, January 22, 1945, Vol. 2, No. 26, p. 38.

Esso of New Jersey Aids Park Program; *Aviation News*, January 29, 1945, Vol. 3, No. 1, p. 39.

[Airport Facilities for Private Flying in the Post-War Period, by William A. M. Burden]; Washington, D.C., Dept. of Commerce, January 30, 1945, 9 pp.

Airpark Surfacing; *Air Tech*, February, 1945, Vol. 6, No. 2, pp. 40, 66.

The Class 1 Airport [Marshall, Minnesota]; *Airports*, February, 1945, Vol. 7, No. 2, pp. 27–31.

Airpark Prescription, by John Paul Jones; *National Aeronautics*, February 1945, Vol. 23, No. 2, pp. 18–20.

Opportunities in Private Airports. Guest Editorial by Glen B. Eastburn; *Southern Flight*, February, 1945, Vol. 23, No. 2, p. 42.

Airports for the West—Airparks; *Western Flying*, February, 1945, Vol. 25, No. 2, pp. 54, 88.

CAA Demonstrates Airpark Construction; *Aviation News*, February 12, 1945, Vol. 3, No. 3, p. 20.

Airparks—a Community Project; *Airports*, March, 1945, Vol. 7, No. 3, pp. 28–29.

Airports for Everybody, by John C. Ross; *Flying*, March, 1945, Vol. 36, No. 3, pp. 40–41.

Airpark Prescription, by Joseph J. Mitchener, Jr.; *National Aeronautics*, March, 1945, Vol. 23, No. 3, pp. 23–24.

You Can't Fly Without Airfields, by Devon Francis; *Popular Science*, March, 1945, Vol. 146, No. 3, pp. 74–81, 211–212.

Eldon, Mo., Votes for Airpark to Become Model Field for Small Towns; *American Aviation*, March 1, 1945, Vol. 8, No. 19, p. 64.

Packaged Airports; *Air News*, April, 1945, Vol. 8, No. 4, pp. 45–46, 48.

Airports Spell Utility for Personal Aircraft, by Joseph T. Geuting, Jr.; *Airports*, April, 1945, Vol. 7, No. 4, pp. 27, 43.

Eldon Leads in Airpark Building; *Airports*, April, 1945, Vol. 7, No. 4, pp. 40–41.

Ten-Year Planning for Private-Flight Ports, by Julian Whittlesley; *Architectural Record*, April, 1945, Vol. 97, pp. 66–109.

Building the Small Airport; Part IV—Turfing, by J. R. Yarrow; *Aviation Maintenance*, April, 1945, Vol. 3, No. 5, pp. 50–53, 104–124.

Community of Aviation Enthusiasts; Miami Aviation Centre to Be Hub of Personal Aircraft Zealots, by William A. Hemler; *Commercial Aviation*, Vol. 7, No. 3, pp. 46, 48, 50.

Airpark Prescription, by Paul E. Young; *National Aeronautics*, April, 1945, Vol. 23, No. 4, pp. 21–22, 28.

Recognition and Encouragement of Privately Owned Fields Urged [by United States Chamber of Commerce]; *Southern Flight*, April, 1945, Vol. 23, No. 4, p. 58.

Influence of Aircraft Landing Areas on American Community Life, by J. E. P. Morgan; *Aero Digest*, April 15, 1945, Vol. 49, No. 2, pp. 62–65, 180.

Private Flying Chief Profit Maker At Detroit Municipal Airport, by D. W. Martin; *Airports*, May, 1945, Vol. 7, No. 5, pp. 28–29, 45.

Airports and Recreation; *American City*, May, 1945, Vol. 60, p. 111.

Building the Small Airport; V. Lighting, by L. C. Vipond; *Aviation Maintenance*, May, 1945, Vol. 3, No. 6, pp. 54–58, 100.

Where Will Air Flivvers Land? by Raymond T. Davis; *Progress Guide*, May, 1945, pp. 371–373.

So You Want to Own an Airport, by George C. Brinckerhoff, as told to M. L. Smith; *Skyways*, May, 1945, Vol. 4, No. 5, pp. 42–43, 88.

Jones Aims to Please the Flying Public, by Herb Packer; *Aviation Service*, May-June, 1945, pp. 10–12, 34.

Urge Airpark-Plans for National Arena; *Aviation News*, May 7, 1945, Vol. 3, No. 15, p. 22.

New Jersey Airpark Adjoins Resort; *Aviation News*, May 21, 1945, Vol. 3, No. 17, p. 18.

Are You Going to Start an Airport? by Paul V. McNamara; *Air Facts*, June, 1945, Vol. 8, No. 6, pp. 28–35.

Cutting an Airpark out of the Woods, by L. B. Farnsworth; *Airports*, June, 1945, Vol. 7, No. 6, p. 32.

Resort-Port, a Model Resort Operation; *Airports*, June, 1945, Vol. 7, No. 6, p. 31.

Airport Planning for Private Flying; *Southern Flight* (*Modern Airports*), June-September, 1945, Vol. 23, No. 6, pp. 42–43, 50; Vol. 24, No. 1, pp. 46–47, 59; No. 2, pp. 44–45; No. 3, pp. 46–47.

"Dirt Road" Airport Program Urged by CAA Advisory Group; *Aviation News*, June 25, 1945, Vol. 3, No. 22, p. 14.

AOPA Cites Small Plane Airport Need; *AOPA Pilot*, July, 1945, pp. 54a–54b.

New Family Field Planned for Detroit; *Aviation News*, July 2, 1945, Vol. 3, No. 23, p. 19.

Extensive Airpark, Plans for New York; *Aviation News*, July 9, 1945, Vol. 3, No. 24, p. 36.

Huge Private Field Projected by Dallas; *Aviation News*, July 9, 1945, Vol. 3, No. 24, pp. 40, 42.

CAA Intermediate Fields Now Available to Public, by Kenneth E. Allen; *American Aviation*, July 15, 1945, Vol. 9, No. 4, p. 40.

Building the Small Airport; Part VI. Paving, by B. H. Biggers and J. P. Cookey; *Aviation Maintenance*, August, 1945, Vol. 4, No. 3, pp. 72–73.

"Pitch in" Airport [Redmond, Oregon]; *Air World*, September, 1945, Vol. 3, No. 6, pp. 32–33.

Your Own Airport! by Kurt Rand; *Flying*, September, 1945, Vol. 37, No. 3, pp. 33–34, 112, 114, 116, 118.

This One's for Private Pilots; One Man's Plan for an Airport and Aero-Recreation for Private Pilots, by H. T. Rowe; *Skyways*, September, 1945, Vol. 4, No. 9, pp. 46–47, 84.

Florida's Super Airpark Miami Aviation Centre . . . a Dream Come True, by Bill Key; *Southern Flight*, September, 1945, Vol. 24, No. 3, pp. 42–43.

Haphazard Airport Operations Stifle Progress, Says Geisse, by Alexander McSurely; *Aviation News*, September 3, 1945, Vol. 4, No. 6, p. 18.

St. Louis to Test Practicability of an "Inside-the-City" Airpark; *Contact*, September 13, 1945, Vol. 10, No. 7, p. 1.

Where Will They Fly? Need for personal aircraft facilities in New York area; *Contact*, September 27, 1945, Vol. 10, No. 9, p. 3.

Grass Roots [Private Airport Situation], by Leighton Collins; *Air Facts*, October, 1945, Vol. 8, No. 10, pp. 72–96.

Building the Small Airport, by Marc Thompson; *Aviation Maintenance*, October, 1945, Vol. 4, No. 5, pp. 48–51, 118–130.

Resort Airpark [Otto Aviation Corp.], by Robert C. Blatt; *Aviation Maintenance*, October, 1945, Vol. 4, No. 5, pp. 37–41.

Hangars

Airplane House; *Air Facts*, April, 1940, Vol. 3, No. 4, pp. 8–9.

Building a Hangar with Limited Funds, by G. Holmes Hansen; *Aero Digest*, October, 1940, Vol. 37, No. 4, pp. 83–84.

Hangar Flying; in which Dr. Boy N. Collier Describes His Hangar-house in Shelton, Washington; *Sportsman Pilot*, March 15, 1941, Vol. 25, No. 3, p. 18.

"-Ill Housed," by William D. Strohmeier; *Air Facts*, April, 1941, Vol. 4, No. 4, pp. 12–15.

Individual Hangar; *Air Facts*, October, 1941, Vol. 4, No. 10, pp. 40–47, 66.

Pointers for Hangar Selection, by George R. Clay; *Southern Flight* (*Modern Airports*); October, 1944, Vol. 24, No. 4, p. 44.

New Plastic Bonded Hangar Developed; *Aviation News*, November 27, 1944, Vol. 7, No. 18, p. 18.

Housing the Family Plane; *Practical Builder*, December, 1944, Vol. 9, No. 12, pp. 16–17.

Hangar Financing Program Developed; *Aviation News*, February 5, 1945, Vol. 3, No. 2, p. 14.

The Hangar Outlook; *Air Tech*, April, 1945, Vol. 4, No. 4, pp. 51–52, 72.

A Barn Becomes a Hangar, by John Abiuso; *Aviation*, April, 1945, Vol. 44, No. 4, p. 168.

All-steel One Plane T-hangars Offer Post-War Shelter Solution, by Alexander McSurely; *Aviation News*, June 11, 1945, Vol. 3, No. 20, p. 17.

Post-War Hangar Types; *Airports*, July, 1945, Vol. 8, No. 1, p. 17.

Dangers and Precautions in Tie-Down Storage, by Gilbert C. Close; *Western Flying*, July, 1945, Vol. 25, No. 7, pp. 38–39, 66, 68.

Hangars for the Private Flyer, by K. E. Van Scoy; *Airports*, September, 1945, Vol. 8, No. 2, pp. 28–29.

Navigation

Air Traffic Rules, by Leighton Collins; *Air Facts*, March 1944, Vol. 7, No. 3, pp. 9–16.

Split-Second Information Service Insures Safe Trips Along Airways; *Civil Aeronautics Journal*, March 15, 1944, Vol. 5, p. 31.

From Pillar to Post, by Prentiss Cleaves; *Skyways*, May, 1944, Vol. 3, No. 5, pp. 28–29, 64, 90, 92.

The Skyway Marker System; a Practical Post-War Plan to Encourage the Private Flying Market; *Aviation and Yachting*, June, 1944, Vol. 12, No. 1, pp. 12, 61.

The Need for Nation-Wide Standard Air Marking System, by John E. P. Morgan; *In* Joint Airport Users Conference, Washington, D.C., July 24–25, 1944. *Proceedings*, pp. 111–118.

Am I Right for Topeka? [Discussion of air marking], by Norman C. Updegraff; *Air Facts*, September, 1944, Vol. 7, No. 9, pp. 78–81.

Air Markers Can Make Private Flying Easy for All; Washington, D.C., Civil Aeronautics Administration, 1945, 4 pp. Press release.

Question of Airport Spacing Brings Clash of Two Plans; *American Aviation*, March 1, 1945, Vol. 8, No. 19, p. 62.

CAA Airport Spacing Standards Criticized by AOPA and NATA; *American Aviation*, April 1, 1945, Vol. 8, No. 21, p. 66.

Private Planes and the VHF Program; *Flying* (*AOPA News*) May, 1945, Vol. 36, No. 5, p. 82.

Postwar Airway Radio Plans Bared by CAA Emphasize Private Flying; Thomas Bourne before Institute of Radio Engineers, New York; *Contact*, May 10, 1945, Vol. 9, No. 3, p. 5.

CAA Takes Action on Air-Markers; Will Serve to Aid Post-War Flyer in X-C's; *Air Ads*, May 20, 1945, Vol. 1, No. 21, pp. 1–2.

The Way to Go Home [Air Marking] by Abraham Segal; *Air Tech*, August, 1945, Vol. 7, No. 2, pp. 26–28.

Signposts of the Sky [CAA Air Markers for Private Flyers], by Norman Carlisle; *Air World*, September, 1945, Vol. 3, No. 6, pp. 29, 68, 72.

Private Aircraft at Terminal Airports, by Wilfred M. Post, Jr.; *Airports*, August, 1945, Vol. 8, No. 2, pp. 59, 68.

Wright Sees Eventual Exclusion of Private Ships from Terminals; *National Aeronautics*, September, 1945, Vol. 23, No. 9, p. 33.

Don't Fence Me In! by Gilbert Brace; *Skyways*, September, 1945, Vol. 4, No. 9, pp. 26–27, 64, 66.

Seaplane Bases

Take to the Water, by Carl Norcross; *Aviation*, May, 1940, Vol. 39, No. 5, pp. 32–35, 94, 97.

Seaplane Bases Are Ready-Made Airports, by George B. Post; *Airports*, September, 1945, Vol. 8, No. 3, p. 72.

Hydroports for the Private Flyer, by Edward Doherty, Jr.; *Flying*, October, 1945, Vol. 27, No. 4, pp. 46–47, 108, 110.

GOVERNMENT

Airworthiness Requirements

Speculations on Airworthiness and Operating Regulations, by Edward Warner; *SAE Journal*, February, 1944, Vol. 52, No. 2, pp. 37–48.

Regulation for Light Aircraft for Private Use, by Edward Warner; *Aeronautical Engineering Review*, June, 1944, Vol. 3, No. 6, pp. 9, 11, 13, 36.

CAA Studies New Design Rules; *Western Flying*, June, 1944, Vol. 24, No. 6, p. 66.

Airworthiness of Lightplanes, by E. W. Norris; *Aero Digest*, June 1, 1944, Vol. 45, No. 5, pp. 56–57, 118, 120.

Board Member [Edward Warner] **Asks for More Liberal View of Private Plane Airworthiness Standards;** *Civil Aeronautics Journal*, June 15, 1944, Vol. 5, p. 67.

Sweeping Requirements Revision Seen As Lightplane Design Spur, by Alexander McSurely; *Aviation News*, April 23, 1945, Vol. 3, No. 13, pp. 29–30.

Statement of AOPA Pilot Opinion, Prepared for the Civil Aeronautics Board July 1945 [on] **Proposed Change,** Part 03 Civil Air Regulations Personal Airplane Design Requirements; Washington Aircraft Owners & Pilots Association, 1945, 12 pp.

New Airworthiness Rules Are Proposed for Safer Airplanes; *Civil Aeronautics Journal*, July 15, 1945, Vol. 6, pp. 73–74.

Industry Urges CAA to Stop Growing Lightplane Restrictions, by Alexander McSurely; *Aviation News*, July 16, 1945, Vol. 3, No. 25, pp. 15–16.

Manufacturers Seek Rule Change in Aircraft Design; *Flying* (*AOPA News*), August, 1945, Vol. 37, No. 2, p. 76.

Civil Aeronautics Administration

War and the CAA, by H. F. Illich; *Flying*, September, 1943, Vol. 33, No. 3, pp. 58, 130.

Asks CAA-Industry Cooperation on Private Aircraft; *American Aviation*, January 1, 1944, Vol. 8, No. 16, p. 70.

CAA and Private Flying, by Fred M. Lanter; *Cub Flier*, November-December, 1944, Vol. 8, No. 2, pp. 2, 4.

Less Rule, More Fields, Better Planes, Smarter Pilots Needed; *National Aeronautics*, December, 1944, Vol. 22, No. 12, p. 40.

Wright Asks Post-War Research in Personal Aircraft; *Aviation News*, December 18, 1944, Vol. 2, No. 21, p. 18.

Another "$700" Airplane? *Southern Flight*, January, 1945, Vol. 23, No. 1, pp. 26–27, 42.

Geisse Named CAA Administrators' Aid on Private Flying; *American Aviation*, January 15, 1945, Vol. 8, No. 16, p. 17.

New Advisory Committee to Have Major Role in Post-War Aviation; *Aviation News*, January 15, 1945, Vol. 2, No. 25, p. 15.

Two Important Jobs Face Geisse in New CAA Personal Plane Post, by Alexander McSurely; *Aviation News*, January 15, 1945, Vol. 2, No. 25, pp. 16, 18.

Wright Names Geisse Aide in Development of Private Aviation; *Civil Aeronautics Journal*, February 15, 1945, Vol. 6, p. 14.

Group to Aid CAA on Private Flying Named by Wright; *Civil Aeronautics Journal*, March 15, 1945, Vol. 6, p. 31.

Private Fliers' Problems to Be Studied by Board Proposed by T. P. Wright; *Civil Aeronautics Journal*, March 15, 1945, Vol. 6, p. 25.

Private Plane Is Job for Industry Alone, J. H. Geisse Declares; *Civil Aeronautics Journal*, March 15, 1945, Vol. 6, p. 32.

Advisory Committee's Recommendations for Non-Scheduled Flying; *Aviation News*, April 2, 1945, Vol. 3, No. 10, p. 18.

Non-Scheduled Flying Group Makes Important Suggestions; *Civil Aeronautics Journal*, April 15, 1945, Vol. 6, p. 38.

Should the CAA Participate in Civil Aircraft Design? *Air Trails*, June, 1945, Vol. 24, No. 3, p. 29.

Flight Examiner CAA Increase Asked by Aviation Groups; *Aviation News*, June 4, 1945, Vol. 3, No. 19, pp. 16, 18.

2,000 Private Pilot Examiners to Be Appointed Soon by CAA; *American Aviation*, July 15, 1945, Vol. 9, No. 4, p. 42.

CAA Private Flying 'Specialists' Named; *Aviation News*, July 16, 1945, Vol. 3, No. 25, pp. 16–17.

Administrator Names Adviser-Consultants to Aid Private Flying; *Civil Aeronautics Journal*, August 15, 1945, Vol. 6, p. 88.

An Open Letter to Ted Wright on CAA Reform [Signed] Grove Webster; *Airports*, September, 1945, Vol. 8, No. 3, p. 57.

Civil Air Regulations

We Need a Simple Plan [for private flying] **What Peace-Time's Greatly Expanded Aviation Activity May Bring in New Regulations;** *Air Progress*, September, 1943, Vol. 3, No. 3, pp. 32–33, 69.

AOPA Hails CAB's Simplified Rules; *Aviation News*, February 7, 1944, Vol. 1, No. 28, pp. 37–38.

Towards Freedom of the Air, by Leighton Collins; *Air Facts*, April, 1944, Vol. 7, No. 4, pp. 29–36.

Too Many Don'ts For Pilots, by George Reiss; *Air Trails*, June, 1944, Vol. 23, No. 3, pp. 26–28, 86.

Making Regulations Fit the Changing Aviation Picture, by Don Flower; *Aviation Review*, June, 1944, Vol. 5, No. 6, pp. 12, 18.

Here Lies Private Flying, by Devon Francis; *Skyways*, June, 1944, Vol. 3, No. 6, pp. 44–47, 92.

Safety Simplified, by J. W. Lankford; *National Aeronautics*, July, 1944, Vol. 22, No. 7, pp. 19–20.

Stanton Recommends CAB Ease Private Plane Repair Regulations; *Civil Aeronautics Journal*, July 15, 1944, Vol. 5, No. 7, p. 77.

Simplified Rules Outlined for Private Flying, by W. L. Russel; *American Aviation*, October 15, 1944, Vol. 8, No. 10, pp. 23–27.

Toward Simpler Air Rules, by Helen Ashby; *Flying*, November, 1944, Vol. 35, No. 5, pp. 55, 90, 94.

Simplification of Regulations, by T. P. Wright; *Aviation Maintenance*, December, 1944, Vol. 3, No. 1, p. 37.

NATA Asks Reforms in Legislation and U.S. Personal Aviation Policy, by Alexander McSurely; *Aviation News*, December 18, 1944, Vol. 2, No. 21, pp. 11–12.

The Proposed New Civil Air Regulations, by Wolfgang Langewiesche; *Air Facts*, January, 1945, Vol. 8, No. 1, pp. 59–81.

What's Wrong With C.A.R.; *Air News*, February, 1945, Vol. 8, No. 2, pp. 38, 43.

CAA and the Lightplane; *Flying*, March, 1945, Vol. 36, No. 3, pp. 48, 138.

The New Civil Air Regulations, by G. Sidney Stanton; *Flying*, March, 1945, Vol. 36, No. 3, pp. 21–22, 120, 122.

CAA Advances Safety of Private Flyer; *Aviation Service*, March-April, 1945, p. 41.

New Civil Air Regulations Presented to CAB; *American Aviation*, April 1, 1945, Vol. 8, No. 21, pp. 64, 66.

Advisory Committee Urges Modernizing of Regulations, by Barbara C. McNamee; *American Aviation*, April 15, 1945, Vol. 8, No. 22, pp. 24, 26.

Private Pilots Urging Simplified Air Regulations South of the Border, by William Kroger; *Canadian Aviation*, June, 1945, Vol. 18, No. 6, pp. 83, 108.

A Challenge to Private Flying; Here's an Important Commentary on the Revised Regulations, by John H. Geisse; *Air Ads*, June 5, 1945, Vol. 1, No. 22, pp. 1–2.

Over-Regulation Will "Hamstring" Designers, CAA Division Warned; *American Aviation*, June 15, 1945, Vol. 9, No. 2, p. 43.

Geisse Sees CAR Revision Private Flier's Big Chance; *Civil Aeronautics Journal*, June 15, 1945, Vol. 6, p. 69.

Major Changes in Pilot Rules; a News Release, Office of Aviation Information, Civil Aeronautics Administration; *Air Facts*, July, 1945, Vol. 8, No. 7, pp. 35–36.

Analyzing the Modified C.A.R., by Joseph T. Geuting; *Airports*, July, 1945, Vol. 8, No. 1, pp. 48, 50.

The New Regulations [Editorial]; *Southern Flight*, July, 1945, Vol. 24, No. 1, p. 8.

Regulations and Their Meaning, by Bill Green; *Southern Flight*, July, 1945, Vol. 24, No. 1, pp. 62, 64, 66.

Industry Generally Favors Revised Air Rules; *American Aviation*, July 1, 1945, Vol. 9, No. 3, p. 15.

2,000 Private Pilot Examiners to Be Appointed Soon by CAA; *American Aviation*, July 15, 1945, Vol. 9, No. 4, p. 42.

Private Flying Affected by CAR Changes; New Air Traffic Rules to Be in Force Aug. 1; *Civil Aeronautics Journal*, July 15, 1945, Vol. 6, p. 74.

CAA, AIAA Reach Compromise on Part 03; *American Aviation*, August 15, 1945, Vol. 9, No. 5, p. 35.

New Civil Air Regulations; *Flying* (*AOPA News*), September, 1945, Vol. 37, No. 3, p. 80.

Thinking of Private Flying? Go Right Ahead; The New CAA Rules Have Cut Red Tape, by Wayne Parrish; *Liberty*, September 1, 1945, Vol. 22, No. 23, p. 10.

New Rules for Easier Flying, by Alec Walker; *Skyways*, October, 1945, Vol. 4, No. 11, pp. 30–31, 90.

Government Aid

Hangar Flying; a Subsidy Plan, by John M. Miller and Arthur A. Maass; *Sportsman Pilot*, Mid-May, 1943, Vol. 29, No. 5, pp. 14–15.

Government's Place in the Development of Private Flying, address by William A. M. Burden before National Light Aircraft Meeting, Institute of the Aeronautical Sciences, April 27, 1944, 6 pp. [CAA Press Release].

Burden Tells How Federal Aids Would Spur Private Flying in Postwar Period; *American Aviation*, May 1, 1944, Vol. 7, No. 25, p. 40.

Private Flying and Problems of Plane Makers Discussed by W. A. M. Burden; *Civil Aeronautics Journal*, May 15, 1944, Vol. 5, pp. 55, 63.

The Government's Place in the Development of Private Flying, by William A. M. Burden, *Aeronautical Engineering Review*, July, 1944, Vol. 3, No. 7, pp. 7, 9, 27.

The USE Program, by Robert H. Hinckley; *Flying*, January, 1945, Vol. 36, No. 1, pp. 76, 124–126.

Another "$700" Airplane? *Southern Flight*, January, 1945, Vol. 23, No. 1, pp. 26–27, 42.

U.S. Aid Proposed for Small Hangars, by Swanee Taylor; *Southern Flight*, January, 1945, Vol. 23, No. 1, p. 45.

Administrator [T. P. Wright] Urges CAA Aid for Builders of Private Airplanes; *Civil Aeronautics Journal*, January 15, 1945, Vol. 6, No. 1, pp. 1, 9.

Hazy Recollections on Old $700 Plane Issue Clarified by Record; *Aviation News*, February 12, 1945, Vol. 3, No. 3, p. 24.

CAA Administrator Urges U.S. Aid: for Private Airplane Builders; *Airman*, March, 1945, Vol. 1, No. 5, p. 10.

Hangar Tempest, There's a Long Story Behind CAA's Proposal to Foster Light Plane Development, by William Kroger; *National Aeronautics*, March, 1945, Vol. 23, No. 3, pp. 15–16, 25–26.

Safer Airplanes at Less Cost, by G. E. Otter; *Aero Digest*, March 15, 1945, Vol. 48, No. 6, pp. 72–73, 203, 205.

Statement of Robert B. Kinkead, Representing Personal Aircraft Council of the Aeronautical Chamber of Commerce of America, Inc.; *In* U.S. Congress. House. Committee on Interstate and Foreign Commerce. Federal Aid for Airports. Hearings, June 1, 1945, pp. 401–415, 505–506.

AOPA Cites Small Airport Need; *AOPA Pilot*, July, 1945, pp. 54a–54b.

We Owe Aviation a Boost; Gov't Promotion of Personal and Civil Aviation Will Carry U.S. to New Economic Heights, by Senator Harley M. Kilgore; *Skyways*, July, 1945, Vol. 4, No. 7, pp. 50–51, 80.

Licenses

Pilot Rating Changes; *Yankee Pilot*, September, 1941, Vol. 4, No. 9, pp. 9–10.

That's a Silly Rule, by Private Pilot; *Air Trails*, October, 1941, Vol. 17, No. 4, pp. 24, 29.

Lapsed License, by Lewin B. Barringer; *Flying and Popular Aviation*, December, 1941, Vol. 29, No. 6, pp. 37, 88, 90.

Have You Been Grounded? by Sedley Peck; *Flying*, June, 1943, Vol. 32, No. 6, pp. 68, 70, 154, 156, 158.

Suggested Requirements for CAA-Rated Mechanics, by R. G. Ojers; *Instruments*, February, 1944, Vol. 17, pp. 97–99.

Simpler Pilot License Rules Proposed As Board Works to Make Flying Easier; *Civil Aeronautics Journal*, April 15, 1944, Vol. 5, pp. 43, 51.

Suggested Revisions of Part 20 of the Civil Air Regulations; *Air Facts*, May, 1944, Vol. 7, No. 5, pp. 72–82.

Is This the Solution? [Suggestions for revision of pilots' licenses], by L. P. Sharples; *Air Trails*, June, 1944, Vol. 23, No. 3, pp. 29, 99–101.

Suggested Revision of Part 24 of the Civil Air Regulations—Mechanic Certificates, by J. W. Lankford; *Instruments*, November, 1944, Vol. 17, pp. 679–680.

Those Horsepower Ratings, by Wolfgang Langewiesche; *Air Facts*, April, 1945, Vol. 8, No. 4, pp. 56–73.

Private Fliers' Notes, by Grove Webster; *Airports*, July, 1945, Vol. 8, No. 1, p. 60.

Private Pilot Licensing May be Accelerated; *American Aviation*, July 1, 1945, Vol. 9, No. 3, p. 47.

Calls for Aviation Certificates More Than CAA Capacity to Test; *Contact*, September 20, 1945, Vol. 10, No. 8, p. 2.

Flying for Fun; 100-Mission Man or Groundgripper, You'll Need a License to Breeze Along the Civil Airways, by Herbert Ringold; *Air Force*, October, 1945, Vol. 28, No. 10, pp. 26–27, 61.

Physical Examinations

Proposed Changes in Physical Standards for Private Pilots, by W. R. Stovall and M. Y. McCormick; *Aero Digest*, October 15, 1944, Vol. 47, No. 2, pp. 58–59, 228.

He Wants You to Fly, from the papers of W. R. Stovall and W. F. Smith; *Air Pilot and Technician*, December, 1944, Vol. 32, No. 6, pp. 14–15, 34.

Handicapped Pilots Restriction Eased by Administrator Wright; *Civil Aeronautics Journal*, December 15, 1944, Vol. 5, p. 136.

Physical Examinations and the Private Flyer, by W. R. Stovall; *Journal of Aviation Medicine*, February, 1945, Vol. 23, pp. 21–25.

Waiver of Physical Requirements in Civilian Flying, by Frank C. Kinsman; *Journal of Aviation Medicine*, February, 1945, Vol. 23, pp. 18–20.

Let's Simplify Medical Exams; *Flying* (*AOPA News*), February, 1945, Vol. 36, No. 2, p. 85.

"Crammed with Complaints," by R. H. Wood; *Aviation News*, March 26, 1945, Vol. 3, No. 9, p. 48.

The Doctor Says No! by James W. Batchelor; *Southern Flight*, April, 1945, Vol. 23, No. 4, pp. 25–27, 40.

Change in CAA Medical Exams for Private Pilots Indicated; *American Aviation*, April 1, 1945, Vol. 8, No. 21, p. 68.

Committee Endorsement Final Push to CAA Medical Rule Changes, by Alexander McSurely; *Aviation News*, April 2, 1945, Vol. 3, No. 10, pp. 7–9.

CAA Okays Simpler Medical Exams; *Aviation News*, April 9, 1945, Vol. 3, No. 11, p. 18.

Private Pilots' Physical Exams May Be Made by Any Doctor, Wright Says; *American Aviation*, April 15, 1945, Vol. 8, No. 22, p. 49.

CAB Eliminates Two Eye Requirements; *Aviation News*, April 16, 1945, Vol. 3, No. 12, p. 17.

'Simplified' Pilot Physical Exam is Circulated; Still Too Complex, by Alexander McSurely; *Aviation News*, May 28, 1945, Vol. 3, No. 18, pp. 15–16.

PERSONAL AIRCRAFT INDUSTRY

General

Light Plane Roundup; *Aviation*, February, 1940, Vol. 39, No. 2, pp. 30–33.

How Luscombe Builds Metal Planes, by Charles Burgess; *Aviation*, May, 1940, Vol. 39, No. 5, pp. 44–45, 102.

Wings for the Average Man; Aircraft Industry Planning for Post-War Mass Production of Private Planes; *American Exporter*, May, 1943, Vol. 132, No. 5, pp. 32, 98.

Postwar Association of Lightplane Makers Proposed by Wallace; *American Aviation*, July 15, 1943, Vol. 7, No. 4, p. 28.

Manufacturers Discuss Forming 'Personal Aircraft' Association; *Aviation News*, August 2, 1943, Vol. 1, No. 1, p. 13.

Light Plane Manufacturers Plan to Have Department in [Aeronautical] Chamber [of Commerce]; *Aviation News*, October 25, 1943, Vol. 1, No. 13, p. 21.

Geuting Sees Big Problem Ahead for Personal Plane Manufacturers; *Aviation News*, November 15, 1943, Vol. 1, No. 16, p. 25.

Air Industry Bearish on Lightplane Field. Sees Little Promise in Meeting Vast Post-War Employment Needs, Report prepared by Industrial Section of National Resources Planning Board Says; *Aviation News*, November 22, 1943, Vol. 1, No. 17, p. 12

Stanton Sees Lightplane Field as Key to Postwar Air Production; *Aviation News*, December 20, 1943, Vol. 1, No. 21, p. 36.

ACC Opens Personal Aircraft Department; *Aviation News*, January 10, 1944, Vol. 1, No. 24, pp. 14–15.

Private Flying Program Expected to Taper Off Post-War Production according to John E. Morgan; *Aviation News*, January 31, 1944, Vol. 1, No. 27, pp. 16–17.

ACCA Group Urges Simplification of Plane Certification System; *Aviation News*, February 28, 1944, Vol. 1, No. 31, p. 16.

Approach to the Post-War Problems of the Personal Aircraft Industry, by C. F. B. Roth; *Aero Digest*, March 1, 1944, Vol. 44, pp. 118–119.

Aviation Industry's Peace Time Potentials, by J. H. Frederick; *American Pilot*, April, 1944, Vol. 5, pp. 10–11.

Personal Aircraft Group Lists Aims; *Aviation News*, April 3, 1944, Vol. 1, No. 36, p. 14.

Post-War Business No Problem to Builders of Ercoupe Planes, by Blaine Stubblefield; *Aviation News*, April 24, 1944, Vol. 1, No. 39, pp. 15–1

Damn the Experts—Go Ahead! *Aero Digest*, May 1, 1944, Vol. 45, No. 3, pp. 66, 134.

United Industry Effort Needed in Private Plane Market; *American Aviation Daily*, May 12, 1944, Vol. 33, pp. 57–58.

Private Plane Output to Keep Pace with Use and New Fields; *American Aviation*, June 1, 1944, Vol. 8, No. 1, p. 43.

Boeing-Wichita Seen As Potential Post-War Personal Plane Builder, by Blaine Stubblefield; *Aviation News*, July 24, 1944, Vol. 1, No. 52, pp. 16–17.

28 Personal Plane Companies Listed [by Personal Aircraft Council of Aeronautical Chamber of Commerce]; *Aviation News*, October 2, 1944, Vol. 2, No. 10, p. 28.

Taylorcraft Lays Plans for Tomorrow; Will Aim at Satisfying the Peacetime Demands of the Private Flyer; *Commercial Aviation*, November, 1944, Vol. 6, No. 9, pp. 42–43, 46.

The Post-War Plane, the Public Won't Get All It Wants—At Least Not Immediately, by J. Carleton Ward, Jr.; *National Aeronautics*, February, 1945, Vol. 23, No. 2, pp. 16–17, 20.

Private Plane Is Job for Industry Alone, J. H. Geisse declares; *Civil Aeronautics Journal*, March 15, 1945, Vol. 6, p. 32.

Getting Down to Cases [personal aircraft manufacturers]; *Southern Flight*, April, 1945, Vol. 23, No. 4, p. 8.

Administrator Wright Sees Private Plane Mainstay of Postwar Aviation Industry; *Civil Aeronautics Journal*, April 15, 1945, Vol. 6, p. 41.

Fly Your Own? Light Plane Makers Face Tough Problem of Meeting Public Demand for All Modern Improvements—and Low Cost; *Business Week*, April 2, 1945, No. 816, pp. 20–21.

Light Plane Go-Ahead; *Aviation News*, April 30, 1945, Vol. 3, No. 14, p. 11.

Lightplane Production Go-Ahead Has Component "Strings" Attached, by Alexander McSurely; *Aviation News*, May 7, 1945, Vol. 3, No. 15, pp. 16–17.

Lightplane Production Obstacles Loom Despite WPB's Go-Ahead, by Alexander McSurely; *Aviation News*, May 21, 1945, Vol. 3, No. 17, pp. 16–17.

Position and Prospects of the Aircraft's Industry [Light Plane Makers] by Phillip Dobbe; *The Magazine of Wall Street*, May 26, 1945, Vol. 76, No. 4, pp. 193–195, 214.

Lightplane Production [editorial by J. Fred Henry]; *Skyways*, June, 1945, Vol. 4, No. 6, pp. 6, 98.

Production Outlook for Personal Planes; *Southern Flight*, June, 1945, Vol. 23, No. 6, pp. 28–29, 40.

The Aviation Industry's Outlook, by J. L. Cohill; *Aero Digest*, June 1, 1945, Vol. 49, No. 5, pp. 52–53, 150.

24,500 Private Planes Promised for First Year; Initial Deliveries This Month; *National Aeronautics*, July, 1945, Vol. 23, No. 7, p. 29.

Wichita Plants to Concentrate on 3 Aircraft Types After War; *American Aviation*, July 15, 1945, Vol. 9, No. 4, p. 22.

Wall Street Eyes the Lightplane Makers, by Raymond L. Hoadley; *Aviation*, August, 1945, Vol. 44, No. 8, pp. 179, 253–255.

Return of the Private Plane, by John C. Ross; *Flying*, August, 1945, Vol. 37, No. 2, pp. 32–34, 78, 80, 84.

Some Lightplane Plants Expect Early Conversions; War Work to Delay Others, by M. L. Smith; *Skyways*, August, 1945, Vol. 4, No. 11, pp. 8, 94.

'Personal Aircraft' Manufacturers Organize As Aero Chamber Section; *Aviation News*, August 9, 1945, Vol. 1, No. 2, p. 8.

More Than 5,000 Lightplanes Promised Before Year's End; *Aviation News*, August 27, 1945, Vol. 4, No. 5, pp. 32, 36.

The Lightplane Dilemma . . . by Lynn L. Bollinger; *Flying*, August-September, 1945, Vol. 37, No. 3, pp. 24–25, 110, 112, 114; No. 4, pp. 65–66, 96, 98, 100.

New Planes on the Way, by George E. Haddaway; *Southern Flight*, September, 1945, Vol. 24, No. 3, pp. 30–31, 62.

First Post-War Airplane off Aeronca Assembly Sept. 5; *Contact*, September 6, 1945, Vol. 10, No. 6, p. 1.

Cost

$1,000 Planes May Make Cloudhopping Popular Sport for Two, by W. D. Hall; *SAE Journal*, March, 1944, Vol. 52, No. 3, pp. 27, 56.

Manufacturing Costs of Planes Analyzed [abstract of paper by A. G. Tsongas and F. S. Macomber]; *Aviation News*, October 2, 1944, Vol. 2, No. 10, p. 28.

Fairchild Head [J. Carleton Ward] Sees Wide Spread in Personal Plane Needs, Prices, by Alexander McSurely; *Aviation News*, November 27, 1944, Vol. 2, No. 18, p. 18.

Cost-Planning the Lightplane, by A. G. Tsongas and F. S. Macomber; *Flying*, January, 1945, Vol. 36, No. 1, pp. 68, 158, 160, 162.

Here's Your Personal Plane; *Air News*, April, 1945, Vol. 8, No. 4, pp. 18–20.

Cost-Planning the Post-War Small Airplane, by A. G. Tsongas and F. S. Macomber; *SAE Journal*, April, 1945, Vol. 53, No. 4, pp. 157–165.

Mass Production, New Tooling Seen Cutting Private Plane Cost; *Aviation News*, May 21, 1945, Vol. 3, No. 25, p. 21.

Pilots See $2,000 Lightplane Price As Post-War Minimum results of AOPA survey; *Aviation News*, June 18, 1945, Vol. 3, No. 21, p. 39.

Utility Is the Range-Finder in Civil Plane Market Forecasts, by N. B. Berboth; *Aviation*, July, 1945, Vol. 44, No. 7, pp. 113–117.

AOPA Members Expect to Pay up to $4,000 for Planes; *American Aviation*, July 1, 1945, Vol. 9, No. 3, p. 50.

Low-Price Plane Potentials, by R. T. Quick; *Aero Digest*, July 15, 1945, Vol. 50, No. 2, pp. 71–73.

WTS Surplus Sale Seen Market Guide; *Aviation News*, July 16, 1945, Vol. 3, No. 25, p. 16.

Viewpoints. Can Planes Be Made As Cheaply As Autos? *Air Trails*, October, 1945, Vol. 25, No. 1, p. 35.

Markets

A Report on the Results of the Small Private Plane Survey Conducted by The Market Research Division During the Months of May–August of 1940; Burbank, Lockheed Aircraft Corporation; September, 1940, 53 pp.

Post-War Aviation Markets for "The Family Car of the Air"; a Survey Made Exclusively for Parks Air College, Inc., by Edward G. Doody & Co., St. Louis, Mo., 1943, 16 p.

Two Car Families to Be Best Plane Market—Stanton; *American Aviation*, April 15, 1943, Vol. 7, No. 22, p. 17.

The Personal Plane Sales Target [Parks Air College Survey], by John Foster; *Aviation*, January, 1944, Vol. 43, No. 1, pp. 116–117, 364, 367, 368.

Figures Soar As Prognosticators Calculate Civilian Plane Market, by J. H. Geisse; *SAE Journal*, March, 1944, Vol. 52, No. 3, p. 28.

Heavy Demands for Small Planes Seen After War; *Civil Aeronautics Journal*, April, 1944, Vol. 5, No. 4, p. 45.

Survey [by John H. Frederick] **Shows Slim Light Plane Market;** *Aviation News*, April 3, 1944, Vol. 1, No. 36, p. 14.

Crowell-Collier Survey Shows 300,000 Want to Buy Planes; *American Aviation Daily*, May 26, 1944, Vol. 33, pp. 124–125.

What Is Our Private Airplane Market? by H. C. Robbins; *American Aviation*, June 1, 1944, Vol. 8, No. 1, pp. 89–90.

112,000 Private Planes Expected by Insurance Official After War; *American Aviation*, July 1, 1944, Vol. 8, No. 3, p. 49.

Where Are Those Marketing Plans? by J. H. Frederick; *Aviation*, August, 1944, Vol. 43, No. 8, pp. 121, 267–270.

Will the Public Buy Planes? *Aviation Review*, September, 1944, Vol. 5, No. 9, p. 7.

Huge Post-War Lightplane Market Shown in Crowell-Collier Survey; *Aviation News*, September 18, 1944, Vol. 2, No. 8, p. 18.

Parks Survey Analyzes Public's Plans for Plane Ownership; *American Aviation Daily*, September 23, 1944, Vol. 35, p. 109.

Erco Sales Conference Points Way to New Plane Marketing Approach, by Alexander McSurely; *Aviation News*, November 20, 1944, Vol. 2, No. 17, pp. 15–16.

Mara Sees Personal Plane as Key to Growth of Aviation in the U.S.; Market Limited Only by Industry's Ability to Produce Safe, Easy-to-Fly Craft at Low Prices, Bendix Executive Says; *Aviation News*, November 20, 1944, Vol. 2, No. 17, pp. 9–10.

Analyzing the Personal Plane Market, by J. T. Geuting; *Airports*, January, 1945, Vol. 7, No. 1, pp. 27, 47.

Survey [Aeronca] **Shows Sixty Per Cent of Post-War Light Planes to Be Owned in Rural Areas;** *Flyaway*, April, 1945, Vol. 1, No. 2, p. 3.

See Farmers As First Plane Buyers; *Aviation News*, April 2, 1945, Vol. 3, No. 10, p. 16.

Private Flying Purchase Potential Swells As Restriction End Nears, by Alexander McSurely; *Aviation News*, April 30, 1945, Vol. 3, No. 14, p. 14.

Private Plane Market to Exceed Transport; *Taylorcraft News*, April-May, 1945, Vol. 6, p. 10.

Postwar Transportation Plan: Rural Dwellers Will Fly [Aeronca Survey]; *Airman*, May, 1945, Vol. 1, No. 7, pp. 9–12.

New One-Place Lightplane Is Market Question Mark; *Aviation News*, May 14, 1945, Vol. 3, No. 16, pp. 48–49.

Lightplane Survey [by Esquire Magazine] **Spots Market Facts;** *Aviation News*, May 21, 1945, Vol. 3, No. 17, p. 17.

The Right Plane for the Right Market; *Airports*, July, 1945, Vol. 8, No. 1, pp. 46–47.

Utility Is the Range-Finder in Civil Plane Market Forecasts; Estimating Personal Plane Market Potentials, by N. B. Berboth; *Aviation*, July, 1945, Vol. 44, No. 1, pp. 113–117.

Low-Price Plane Potentials, by R. T. Quick; *Aero Digest*, July 15, 1945, Vol. 50, No. 2, pp. 71–73.

Private Plane Sales May Exceed 20,000, by Richard King [abstract]; *SAE Journal*, August, 1945, Vol. 53, No. 8, p. 48.

Survey [Crowell-Collier] **Shows Increase in Post-War Private Flying,** abstract by Ray Robinson; *SAE Journal*, September,1945, Vol. 53, No. 9, p. 37.

Know Your Air Market, by Bill Green; *Southern Flight*, September, 1945, Vol. 24, No. 3, p. 66.

Merchandising

They Should Be Flying [Businessmen]; *Sportsman Pilot*, December 15, 1939, Vol. 22, No. 6, pp. 8–9.

Westerners Sell Airplanes! by Carl Elkins; *Western Flying*, January, 1941, Vol. 21, No. 1, pp. 22–23.

Prescription for Progress [promoting private flying], by W. J. Arnold; *Western Flying*, May, 1941, Vol. 21, No. 5, p. 38.

The Pattern of Future Aircraft Sales, by J. T. Geuting; *Western Flying*, January, 1944, Vol. 24, No. 1, pp. 44–45, 108.

The Transportation Shortage Is Our Opportunity, by Don Valentine; *Air Facts*, February, 1944, Vol. 7, No. 2, pp. 34–40.

Memo to Operators; Here Are the Planes You May be Selling in 195?; *American Pilot*, March, 1944, Vol. 5, pp. 14–15, 27.

Approach to the Post-War Problems of the Personal Aircraft Industry, by C. B. F. Roth; *Aero Digest*, March 1, 1944, Vol. 44, No. 5, pp. 118–119.

Aeronca's Postwar Selling Plan, by Al Bennett; *Commercial Aviation*, September, 1944, Vol. 6, No. 7, pp. 56, 58, 60.

New Wrinkle in Merchandising; *Air Transportation*, October, 1944, Vol. 5, No. 4, pp. 62–64.

A Lightplane Manufacturer Looks Out in Front, by John W. Friedlander; *Aero Digest*, November 15, 1944, Vol. 47, No. 4, pp. 73–76.

Marketing Tomorrow's Light Plane, by W. R. Winans; *Aero Digest*, November 15, 1944, Vol. 47, No. 4, pp. 58–59, 138, 194.

We Must Sell Private Flying, by B. M. Towle; *Air Facts*, December, 1944, Vol. 7, No. 12, pp. 9–13.

Aeronca's Post-War Plan; *Airman*, December, 1944, Vol. 1, No. 2, pp. 10–11.

You Can't Sell More Light Planes Than People Can Afford; Neville; *National Aeronautics*, December, 1944, Vol. 22, No. 12, pp. 39–40.

Sales Methods to Be Vital Factors in Personal Plane Market Fight [abstract of address by Lynn L. Bollinger before American Marketing Association]; *Aviation News*, December 25, 1944, Vol. 2, No. 22, pp. 21–22.

Marketing Personal Airplanes, by Lynn L. Bolinger; *Harvard Business Review*, Winter Number, 1944, Vol. 23, No. 2, pp. 217–228.

Analyzing the Personal Plane Market, by Joseph T. Geuting; *Airports*, January, 1945, Vol. 7, No. 1, pp. 27, 48.

Who Will Sell the Planes? *Western Flying*, January, 1945, Vol. 25, No. 1, p. 39.

New Coast Group Maps Program of Merchandising Private Flying, by Scholer Bangs; *Aviation News*, January 22, 1945, Vol. 2, No. 26, p. 15.

Service Will Sell the Personal Plane, by E. C. Laird; *Aviation Maintenance*, February, 1945, Vol. 3, No. 3, pp. 46, 128.

WPB Takes Orders for Small-Aircraft Plants When War Jobs End; *The Wall Street Journal*, March 23, 1945.

RFC Surplus Plane Ads Threaten Damage to Private Flying Future; *Aviation News*, April 9, 1945, Vol. 3, No. 11, p. 17.

Sales Are Made by Showing the Goods, by John Abiuso; *Aviation*, May, 1945, Vol. 44, No. 5, pp. 178–179.

To Foster the Sale and Use of the Personal Plane, by James C. Baggott; *U. S. Air Services*, May, 1945, Vol. 30, No. 5, pp. 32, 36.

Aviation, F. O. B., by R. E. "Duke" Iden; *Flying Aces*, June, 1945, Vol. 50, No. 3, pp. 36–37, 60–61.

Private Aviation Growth Depends on Aggressive Merchandising, by Harold E. Green; *Printers' Ink*, June 1, 1945, Vol. 211, No. 9, pp. 21–22, 94, 96–98.

Where Do We Go From Here? by C. C. Moseley; *Aero Digest*, June 15, 1945, Vol. 49, No. 6, pp. 40–41, 108.

Department Store Plane Sales Set by Marshall Field, Parks, by Karl Hess; *Aviation News*, June 18, 1945, Vol. 3, No. 21, pp. 35–36.

The Right Plane for the Right Market; *Airports*, July, 1945, Vol. 8, No. 1, pp. 46–47.

The Selling Job Ahead; *Western Flying*, July, 1945, Vol. 25, No. 7, p. 37.

The Stinson Plan: to Simplify Aircraft Servicing; *Airman*, August, 1945, Vol. 1, No. 9, pp. 4–5.

Selling Personal Planes; *Banking*, August, 1945, Vol. 38, No. 2, pp. 41, 76.

Down-to-Earth Planning for Sky-High Sales; *Modern Industry*, August 15, 1945, Vol. 10, No. 2, pp. 33-37.

New Lightplane Market Trend Emphasizes Modern Salesmanship, by Alexander McSurely; *Aviation News*, October 1, 1945, Vol. 4, No. 10, p. 14.

WORLD WAR II

Private Flying and the War; *Aviation*, March, 1942, Vol. 41, No. 3, pp. 150, 201.

The Private Pilot and the War, by Charles I. Stanton; *Flying and Popular Aviation*, April, 1942, Vol. 30, No. 4, pp. 23–24, 88, 90, 96.

The War and the Lightplane, by William T. Piper; *Flying and Popular Aviation*, July, 1942, Vol. 31, No. 1, pp. 56, 108–109.

Light Planes Being Overlooked, by W. T. Piper; *Aero Digest*, November, 1942, Vol. 41, No. 5, pp. 142–143, 385.

Private Fliers to the Rescue, by Russ Johnston; *Flying and Popular Aviation*, October, 1942, Vol. 31, No. 4, pp. 44–46, 112.

The Lightplane Joins the Army, by Alfred Toombs; *Flying and Popular Aviation*, November, 1942, Vol. 31, No. 5, pp. 59–60, 149.

Report on Civil Air Patrol; Washington, D.C., Office of War Information, June 25, 1943, 25 pp.

CAP Shows the Nation, by Robert H. Wood; *Aviation News*, August 23, 1943, Vol. 1, No. 4, p. 30.

"Grasshoppers" Prove Worth in War, by Franklin M. Reck; *Aero Digest*, April 1, 1944, Vol. 45, No. 1, pp. 75, 210.

OUTSIDE U.S.

Africa

Strong [British] **Group Will Produce Special Plane for Use in Africa;** *International Aviation*, February 16, 1945, Vol. 2, p. 182.

Alaska

Alaska Adventure, by Caroline Iverson; *Flying*, December, 1942, Vol. 31, No. 6, pp. 33–34, 115–116.

Good Market for Personal Planes Seen in Alaska in Post-war Era; *Aviation News*, March 6, 1944, Vol. 1, No. 32, pp. 41–42.

Alaska Is Seen [by Burleigh Putnam] **as Holiday Land for Peacetime Private Flyers;** *Civil Aeronautics Journal*, September 15, 1944, Vol. 5, No. 9, p. 102.

Alaskan Junket, by John F. Rudy; *Air Trails*, January, 1945, Vol. 23, No. 4, pp. 24–25, 72–78, illus.

Australia

Light Types for Post War, by Vivigani; *Aircraft*, June, 1945, Vol. 23, No. 9, pp. 23–24.

Prospects of Post-war Private Flying; *Aircraft*, March, 1945, Vol. 23, No. 6, pp. 12–13, 23.

Canada

Post-war Flying Clubs; *Commercial Aviation*, March, 1943, Vol. 5, No. 3, p. 21.

Should We . . . Tighten Regulations Now . . . and Impose New Rules, Yes, by Lloyd Sloan, No, by Keith Edgar; *Canadian Aviation*, June, 1944, Vol. 17, No. 6, pp. 80, 101–102.

RCAF Group Forms Private Flying Unit; *Aviation News*, June 5, 1944, Vol. 1, No. 45, p. 18.

Light Aircraft in a Postwar Era, [signed William A. Hunter]; *Commercial Aviation*, March, 1944, Vol. No. 3, pp. 35–36.

Air Camps of the Future, by Chas. E. Smith; *Aviation Review*, June, 1944, Vol. 5, No. 6, pp. 16, 18.

Re-establishment of Flying Clubs Urged [by British Aviation Insurance Co.]; *International Aviation*, October 13, 1944, Vol. 2, No. 2, p. 22.

Why Not Make Available . . . Surplus Light Planes . . . to Encourage Private Flying? by John D. Caron; *Canadian Aviation*, November, 1944, Vol. 17, No. 11, p. 118.

Importance of the Resort Air Park; Canadian Resorts Equipped With Landing Strips Will Bring Air Tourists to the Dominion in Great Volume; *Aviation Review*, January, 1945, Vol. 6, No. 1, p. 9.

Canadian Pilot Says . . . Utility Postwar Keynote . . . for Private Plane Sales, by Stuart E. Alexander; *Canadian Aviation*, February, 1945, Vol. 18, No. 2, p. 83.

Dominion-wide Response as . . . Flying Club Men Meet . . . to Plan for Their Future; *Canadian Aviation*, March, 1945, Vol. 18, No. 3, pp 71–72.

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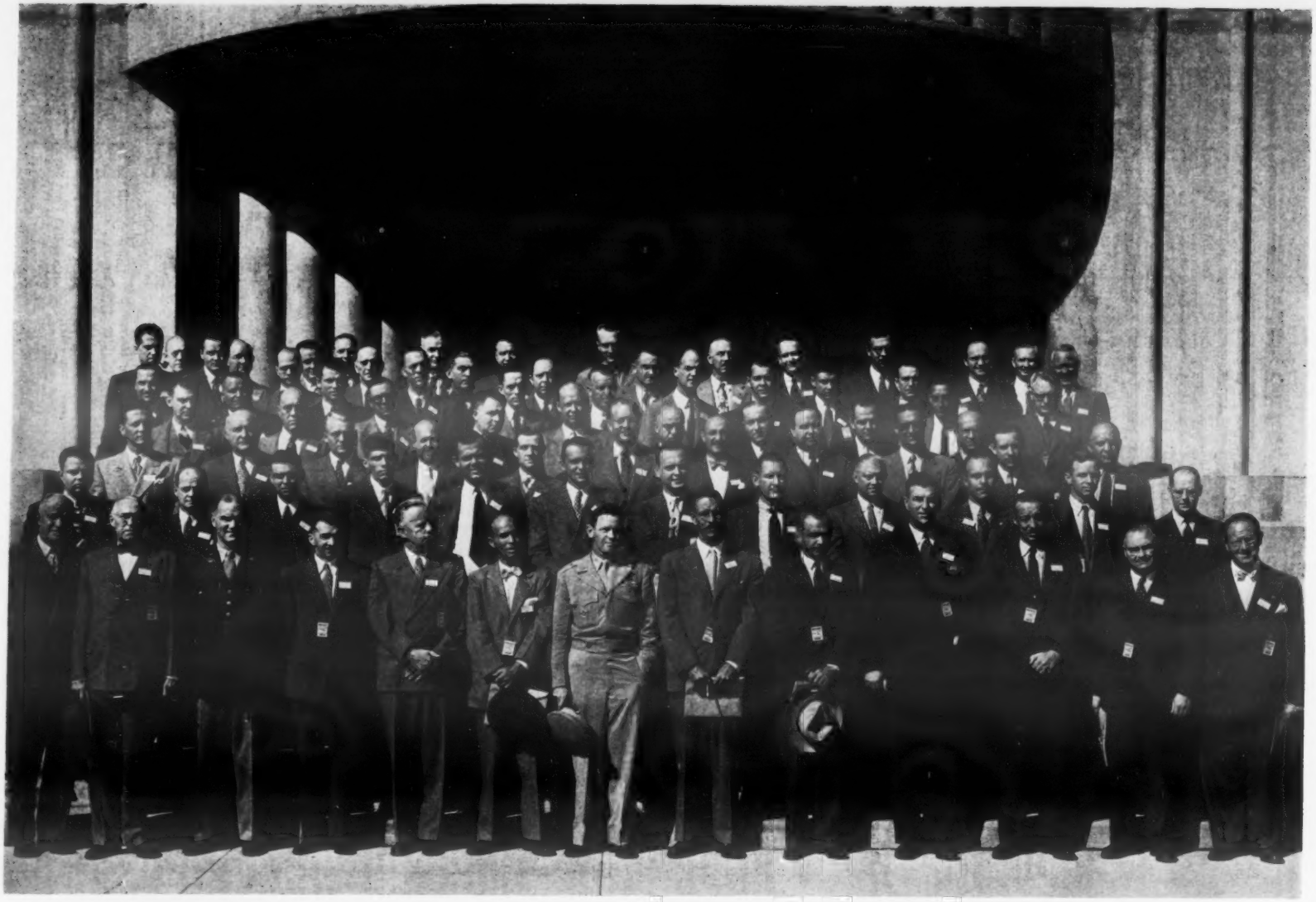


Air Technical Service Command Photo

Institute Members and Officers from Wright and Patterson Fields at the second inspection of the facilities and operations of the Air Technical Service Command.

Institute News

Second Visit of Institute Members to Wright and Freeman Fields

The October issue of the AERONAUTICAL ENGINEERING REVIEW reported the visit of Institute members to Wright and Freeman Fields on September 14 and 15, at the invitation of the Commanding General of the Air Technical Service Command, to inspect the facilities and operations of the A.T.S.C. On September 21 and 22 a second group of 77 members of the Institute made a similar tour and inspection. Mr. Orville Wright was in attendance at both tours.

The program was substantially that of the preceding week but the scheduled trip to the Wind Tunnels was canceled and the members visited the Power Plant Laboratory instead. On Friday evening, September 21, the members and officers from Wright and Patterson Fields dined at the Patterson Field Officers' Club where Brig. Gen. Lawrence C. Craigie, Chief of the Engineering Division of the A.T.S.C., addressed the group. Mr. Grover Loening and Dr. Clark B. Millikan, Past President of the Institute, also spoke.

On Saturday, September 22, the group visited Freeman Field at Seymour, Ind., to examine enemy aircraft equipment, after which they returned to Wright Field.

A list of those in attendance at the second trip follows: D. W. Anderson, Vice-President, Firestone Aircraft Company; A. Francis Arcier, Vice-President—Engineering, The Waco Aircraft Company; Charles W. Baker, Assistant Manager of Sales, The National Screw & Manufacturing Company; Preston Bassett, Vice-President, Sperry Gyroscope Company, Inc.; E. A. Bellande, Assistant to President, AiResearch Manufacturing Company; Guy E. Beardsley, Assistant to Chief Engineer, Pratt & Whitney Aircraft Division, United Aircraft Corporation; Don O. Benson, Superintendent of Aircraft Engineering, Northwest Airlines, Inc.; George W. Brady, Chief Engineer, Propeller Division, Curtiss-Wright Corporation; H. F. Brinen, Chief Research Engineer, Young Radiator Company; Woodward Burke, Director of Flight Research, McDonnell Aircraft Corporation; A. K. Bushman, Charge of Commercial Engineering, General Electric Company; A. T. Colwell, Vice-President, Thompson Products, Inc.; I. M. Coppock, President, The Variety Aircraft Corporation; Carl De Ganahl, Director of Research, Fleetwings Division, Kaiser Cargo, Inc.; Robert R. Dexter, Secretary, Institute of the Aeronautical Sciences; Oscar Erlandsen, Jr., Chief Structures Engineer, Grumman Aircraft Engineering Corporation; Herbert G. Fales, Vice-President, The International Nickel Company, Inc.; K. R. Ferguson, Vice-President, Northwest Airlines, Inc.; Frederic Flader, President, Frederic Flader, Inc.; George R. Forman, Assistant to the President, Institute of the Aeronautical Sciences; Charles Froesch, Chief Engineer, Eastern Air Lines, Inc.; Jack Frye, President, Transcontinental & Western Air, Inc.; C. C. Furnas, Director of Research, Airplane Division, Curtiss-Wright Corporation; Lester D. Gardner, Chairman of the Council, Institute of the Aeronautical Sciences; J. C. Garrett, President, AiResearch Manufacturing Company and the Garrett Corporation; E. B. George, Vice-President and Chief Engineer, Leland Electric Company; B. Allison Gillies, Consulting Engineer, Ryan Aeronautical Company; Clement L. Griffin, Assistant Vice-President, Walter Kidde & Company, Inc.; S. D. Hackley, Vice-President, Fleetwings Division, Kaiser Cargo, Inc.; A. F. Haiduck, Vice-President and Factory Manager, Bellanca Aircraft Corporation; R. M. Hazen, Chief Engineer, Allison Division, General Motors Corporation; W. C. Heath, Chief Engineer, Solar Aircraft Company; J. A. Herlihy, Vice-President, Operations, United Air Lines, Inc.; J. J. Hilt, Vice-President, Young Radiator Company; Bennett H. Horchler, Executive Vice-President, Institute of the Aeronautical Sciences; William S. Hough, Manager, Aircraft Section, Johns-Manville Sales Corporation; Richard Hutton, Chief Development Engineer, Grumman Aircraft Engineering Corporation; Albert R. Jacobs, Aircraft Engine Executive, Jacobs Aircraft Engine Company; R. D. Kelly, Superintendent of Engineering Development, United Air Lines, Inc.; Herbert Reeves Kirby, Aircraft Manager, Owens-Corning Fiberglas Corporation; R. P. Kroon, Manager of Engineering, Aviation Gas Turbine Division, Westinghouse Electric Corporation; A. W. Kuhner, Koehler Aircraft Products Company; H. L. Laube, Vice-President, Engineering Division, Carrier Corporation; John C. Lee, President, Menasco Manufacturing Company; John G. Lee, Assistant Director of Research, United Aircraft Corporation; E. E. LeVan, President, Haynes Stellite Company; Grover Loening, Aircraft Consultant, National Advisory Committee for Aeronautics; Ludwig A. Majneri, Vice-President of Engineering, Warner Aircraft Corporation; J. S. McDonnell, President, McDonnell Aircraft Corporation; W. J. McGoldrick, Vice-President-Engineering, Minneapolis-Honeywell Regulator Company; Clark B. Millikan, Professor of Aeronautical Engineering, California Institute of Technology; J. D. Miner, Jr., Manager of Aviation Engineering Department, Westinghouse Electric

Institute Members and Officers from Wright and Patterson Fields at the second inspection of the facilities and operations of the Air Technical Service Command.

Air Technical Service Command Photo

Photograph Courtesy Air Technical Service Command

The Q-14 radio-controlled target plane poised on its catapult prior to take-off at Wright Field. This plane was demonstrated to members of the Institute inspecting the facilities of the Air Technical Service Command on September 14–15 and 21–22.

Here Comes Essair!

Phillips Hails a Bright New Star in Southwest Aviation

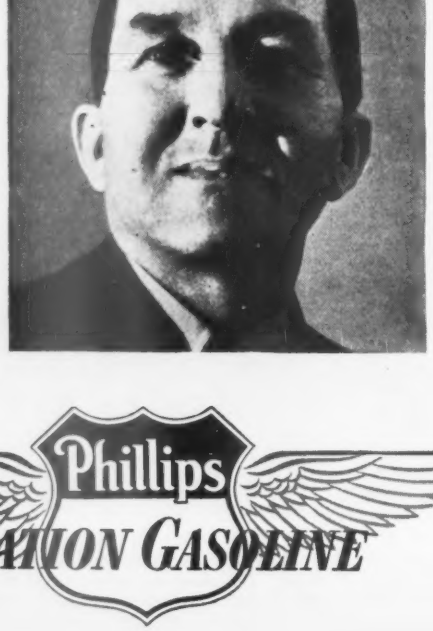
"I WANT to run an airline—and a good one!" You can't hate a guy who talks like that—particularly when the guy is a person like Bill Long, president of Essair, Inc.

Essair, as you probably know by now, is the new feeder line "flying the range"—Amarillo—Lubbock—Abilene—San Angelo—Austin—Houston.

Headed by a group of executives whose middle names are Aviation, blessed with an unusual pool of flying talent, we confidently predict that Essair, and Major Bill Long, are going to be a mighty important factor in the Southwest's postwar aviation picture.

And nobody'll be any happier than we if they are—because Phillips Aviation Gasoline powers their ships. If you think a pretty good tip-off on a product is the kind of companies and people who use it, we're glad to have you know Essair is on our side. We've *earned* their respect with our products and services—we'd like a chance to earn yours. If you have a problem involving aviation fuel, write to us at, Aviation Department, Phillips Petroleum Company, Bartlesville, Oklahoma.

Two of the Lockheed Electras now "flying the range" for Essair, Inc.



Major Bill Long of Essair, who has been identified with aviation in all its phases since 1917.

Phillips
AVIATION GASOLINE

Corporation; C. E. Mines, Coordination Engineer, Packard Motor Car Company; Frank C. Mock, Manager, Aircraft Carburetor Engineering, Sales & Service, Bendix Products Division, Bendix Aviation Corporation; W. J. Morrison, Engineering Manager, Simmonds Aerocessories, Inc.; Reeves Morrisson, Analytical Engineer, Pratt & Whitney Aircraft Division, United Aircraft Corporation; A. F. Newell, President, Kenyon Instrument Company, Inc.; Dana W. Newell, Vice-President and Assistant Chief Engineer, Kenyon Instrument Company, Inc.; John K. Northrop, President, Northrop Aircraft, Inc.; S. M. Norwood, Vice-President, Electro Metallurgical Company; G. A. Page, Jr., Director of Engineering, Airplane Division, Curtiss-Wright Corporation; Will D. Parker, Manager, Aviation Division, Phillips Petroleum Company; William J. Perfield, Chief Engineer, Lear, Inc.; Perry W. Platt, Project Engineer, Pratt & Whitney Division, United Aircraft Corporation; H. M. Ricks, Manager, Aircraft and Tachometer Sales, Weston Electrical Instrument Corporation; T. Claude Ryan, President, Ryan Aeronautical Company; Welman A. Shrader, Editor, Aeronautical Engineering Catalog, Institute of the Aeronautical Sciences; Walter H. Skidmore, Chief, Aircraft Engineering Division, Weston Electrical Instrument Corporation; Ralph L. Skinner, President, Skinner Purifiers, Inc.; Robert M. Stanley, Chief Engineer, Bell Aircraft Corporation; Harry A. Sutton, Aeronautical Engineer, The Glenn L. Martin Company; Harold R. Talbot, Executive Vice-President and Treasurer, Kenyon Instrument Company, Inc.; George Don Welty, Engineer, Aluminum Company of America; Robert M. Williams, Chief Design Engineer, Packard Motor Car Company; G. H. Woodard, Manager, Aviation Gas Turbine Division, Westinghouse Electric Corporation; Orville Wright; Cole Younger, Vice-President, Chase National Bank.

T. P. Wright Receives Daniel Guggenheim Medal for 1945

Theodore P. Wright, Past President and Fellow of the Institute, and Administrator of the Civil Aeronautics Administration, has been selected to receive the Daniel Guggenheim Medal for the year 1945. The announcement of the award was made by Dr. George W. Lewis, Chairman of the Board of Award.

The award was made to Dr. Wright "for outstanding contributions to the development of civil and military aircraft and for notable achievement in assuring the success of our wartime aircraft production program." His achievements in the military aircraft production program as a member of the Aircraft Production Board and as Director of the Aircraft Resources Control Office contributed largely to his selection for the Guggenheim award. For these achievements he had previously received the War Department's highest award to civilians, the Army's Commendation for Exceptional Service, as reported in the AERONAUTICAL ENGINEERING REVIEW for June, 1945. Also considered in the Guggenheim Medal award were the recipient's many technical contributions over the years as a leading aeronautical engineer and executive, including development of the airplane that won the $100,000 Award in the Guggenheim Safe-Aircraft Competition of 1930.

The Daniel Guggenheim Medal was created for the purpose of honoring persons who make notable achievements in the advancement of aeronautics. Provision for the Medal was made in 1928 by a gift from the Daniel Guggenheim Fund for the Promotion of Aeronautics.

Gifts to the Aeronautical Archives

Mrs. James Means, of Boston, sent an etching of Dr. John Jeffries, the eighteenth century American aeronautical pioneer, and a letter bearing Dr. Jeffries' signature. A model of the German V-1 flying bomb was received from the Air Technical Service Command through the courtesy of Col. T. B. Holliday. Sixty-two insignia of the Red Army Air Forces were received from The Government Purchasing Commission of the Soviet Union in the U.S.A., through the courtesy of Col. I. P. Kramarenko.

The Association Française des Ingenieurs et Techniciens de l'Aéronautique gave a complete file of its publication, *Technique et Science Aeronautiques*, through Capt. Robert V. Boname. The McGraw-Hill Publishing Corporation sent 53 books, 26 bound volumes of periodicals, and 203 unbound issues of foreign and domestic periodicals, through the courtesy of Leslie E. Neville, adding to its previous generous gifts. Additions to their previous gifts were received from Mrs. Bella C. Landauer, who sent historical photographs; Dr. Alexander Klemin, who sent books and pamphlets; and Paul H. Wilkinson, who sent files of the *Junkers Nachrichten* and *Intava World* and a catalog of the Dornier-Werke.

T. P. Wright.

Peter F. Rossmann sent 14 files on production and materials. Archibald Black gave 19 aeronautical books. Dr. Otto Kallir added a scarf of aeronautical design to his previous gifts. The Glenn L. Martin Company gave its *Structural Design Manual*, *Drafting Room Manual*, *Standard Shapes Book*, and a file of *Plane Tips*, through the courtesy of F. D. Jewett.

The British Air Commission in Washington added 16 *British Air Ministry Translations* to the large number previously given. The Pacific-Alaska Division of Pan American Airways, Inc., gave a file of *The Clipper*, and the New York office of this company gave two early issues of *Pan American Air Ways*.

Leon Z. Seltzer gave aeronautical books. A file of *Aviation Engineer Notes* was received from the Office of the Air Engineer of the Army Air Forces. A set of display miniature bearings was received from Miniature Precision Bearings.

Documents relating to applications for new air routes and extensions of existing routes before the Civil Aeronautics Board were received from Braniff Airways, Inc., Spartan Aircraft Company, Inc., Transcontinental & Western Air, Inc., and United Air Lines, Inc.

Additional gifts were received from Abbott Laboratories, Inc., Aero Services, Inc., Aeronautical Radio, Inc., *Brooklyn Eagle*, Consolidated Vultee Aircraft Corporation, Dow Chemical Company, Fairchild Engine & Airplane Corporation, G & A Aircraft, Inc., Heat Exchange Institute, *Philadelphia Record*, Robert E. Phillips, Sperry Gyroscope Company, Inc., and the U.S. Bureau of Aeronautics of the Navy Department; Civil Aeronautics Administration; and the Petroleum Administration for War.

New Corporate Member

The Hilliard Corporation, Elmira, N.Y., has recently become a Corporate Member of the Institute. The activities of the company in the aeronautical field are in the manufacture of three types of purifiers for lubricating oil, and the production of six standard types of industrial clutches and standard and special clutches for aircraft use.

The products of the Oil Purifier Division are of three types. Hilco Flite Filters are attached to airplane engines for continuous filtration of the lubricating oil throughout the time the engine is in operation. The Hilco Portable Ground Filter is moved up to airplanes from which the oil is drawn into a receiver; the oil is then quickly filtered and delivered to a clean oil receiver, from which it is returned to the airplane engine. A complete oil change and filtering of the oil is accomplished in 10 to 15 min. A third prod-

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PRODUCTS

Many civilian products will require precision-made screws of the same high quality that has been perfected for aircraft instruments.

Formerly, it was considered necessary to use Swiss watch-making machinery to produce this fine precision which "National", by its method of upsetting and finishing the head and rolling the thread, has produced all through the war.

From the tiniest screw to the largest sizes, accuracy and uniformity are maintained through "National's" methods of manufacture and thorough inspection. Furnished in many grades of ferrous and nonferrous metals, e.g., carbon steels, stainless steels, brass or bronze.

Let us have your inquiry.

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uct is the Hilco Airline Oil Purifier, which is installed in the shop and used to re-refine or recondition contaminated engine-lubricating oil by the batch method. The type of equipment used for lubricating-oil purification depends upon local operating conditions and the method preferred by individual operators.

In addition to the six standard types of industrial clutches, namely, single-revolution, overrunning, friction, slip, centrifugal, and overload release types, it has been the policy of the company to manufacture special clutches to meet individual requirements. This policy has led to the development of extensive work for the aircraft industry. Special clutch units are required in nearly all aircraft applications and these problems have been solved by designing individual types of overrunning, centrifugal, and safety units in connection with supercharger drives, rotor control on helicopters, dual-drive propellers, hand control of airplane canopies to provide automatic locking in any position, and two-speed control of other mechanisms.

Sections and Branches

Buffalo Section

At a meeting of the Buffalo Section on September 18 the following new officers were installed: Chairman, Edward E. Foster, Head of Structures, Materials, and Weights, Airplane Division, Curtiss-Wright Corporation; Vice-Chairman, R. A. Wolf, Chief Research Engineer, Bell Aircraft Corporation; Secretary, Dexter Rosen, Senior Flight Research Engineer, Bell Aircraft Corporation; Advisory Committee, Ray P. Whitman, First Vice-President and Manager, Niagara Frontier Division, Bell Aircraft Corporation; George A. Page, Jr., Director of Engineering, Airplane Division, Curtiss-Wright Corporation.

Dr. Claude E. Puffer, Dean of Administration of the University of Buffalo, gave a talk on "The Economic Characteristics of the Air Transport Industry." Two checks of $50 each, contributed by Curtiss-Wright Corporation and Bell Aircraft Corporation, respectively, were presented to Benson Hamlin, Design Development Engineer, of Bell Aircraft Corporation, for the best paper presented during the preceding year. The paper was titled "Jet Propulsion," and the presentation was made by Lawrence D. Bell, President of Bell Aircraft Corporation.

Miami Section

At a postponed election, completed on October 1, the following officers of the Miami Section were elected: Chairman, B. C. Stephens, Assistant Division Engineer; Vice-Chairman, R. C. Zinn, Assistant Division Engineer; Secretary-Treasurer, C. R. Ursell, Junior Structures Engineer; all of Pan American Airways, Inc.

Preparation of the constitution for the Miami Section is under way. It has been decided that the membership of the Section will comprise members of the Institute in good standing residing in or near the counties of Dade and Broward, in Florida. It is planned to schedule meetings on an average of once a month but provisions have been made for calling special meetings if occasions arise when a speaker is in town. It is expected that there will be many such occasions in the future because the Miami Section has a large and important potential field from which to draw guest speakers.

San Diego Section

At a dinner meeting held on October 5 in the Gold Room of the U. S. Grant Hotel, the principal speaker was Ernest G. Stout, Past Chairman of the San Diego Section and Design Staff Engineer of Consolidated Vultee Aircraft Corporation. Mr. Stout gave an illustrated talk about his technical mission to Germany. He had obtained permission to disclose not only the details of his travels, but information concerning the progress made by Germany in aircraft development up to the end of the war. He gave details about aircraft design and construction and research facilities, both completed and still on the drawing boards. His report referred to his travels through English- and American-controlled sections of Germany and Austria, as well as to the Russian sector of Berlin which had recently been closed to newspaper men and engineers from the United States and Great Britain. The report of his observations of the occupied countries included information that has not been made available elsewhere.

Mr. Stout also gave a complete report about his recent trip to the Pacific war area, the details of which have been released from restrictions as a result of the end of the war with Japan. Following the address, Mr. Stout opened the meeting to questions.

Seattle Section

On October 10 a dinner meeting of the Seattle Section was held at the Chamber of Commerce Hall. The general topic of the meeting was light aircraft.

The papers presented were "What the Market Offers," by Don Wheeler, of Boeing Aircraft Company; "Roadable Aircraft," by John Holmes, of Boeing Aircraft Company; and "Rotary Wings," by Horace Pentecost, designer of the "Hoppicopter."

Washington, D.C., Section

The first Fall meeting of the Washington Section took place on October 3 at the United States Chamber of Commerce Building. The principal speaker was Dr. A. H. Taylor, Chief Coordinator for Electronics at the Naval Research Laboratory.

His subject was "Radar in the War." Dr. Taylor is regarded as one of the leading scientists in the field of electronics and was a pioneer in the development of radar for aeronautical use. At the close of the talk an opportunity was provided for general discussion from the floor.

Academy of Aeronautics

At a business meeting on September 11, the following officers were elected: Chairman, Thomas J. Knust; Vice-Chairman, Frank Tedesco; Secretary, Margaret Liebhauser; Corresponding Secretary, Adolfo Luis Munoz; Treasurer, Albert Demchak; Faculty Adviser, Milton Edwards. Harry J. Roffelsen was elected Honorary Chairman and Nicholas D. Kintzer Co-Honorary Chairman.

On September 17 a routine meeting was held but no formal program was presented and there were no speakers. A special meeting took place on September 20 for the prospective members, at which they were given information about the Institute and the procedure of initiations.

It was decided to hold the initiation of new members on October 15 and a special committee was appointed, consisting of D. McElwain, Chairman, A. Munoz, and E. Siekerski.

At a meeting on September 24 the Treasurer reported on the financial standing of the Academy of Aeronautics Student Branch and it was decided to schedule meetings regularly for the period of 3:00 to 3:30 p.m. on each meeting day.

Massachusetts Institute of Technology

At a business meeting on September 12 the M.I.T. Student Branch made plans for a future visit to the plant of the Chance Vought Aircraft Division of United Aircraft Corporation. It was expected that between 20 and 30 members of the Branch would make the trip.

A special meeting of the Officers of the Branch took place on September 20, at which plans were discussed for the operation of the organization during the forthcoming new term.

University of Michigan

A technical meeting of the Student Branch was held on August 20. Dr. A. M. Kuethe, of the Department of Aeronautical Engineering of the University of Michigan, gave a talk titled "Compressibility Effects." The talk was supplemented by the showing of an N.A.-C.A. film.

On August 28, Thomas A. Kerr, Regional Traffic Manager of Pennsylvania-Central Airlines Corporation at Detroit, spoke on the subject "Future Prospects of Air Cargo." A business meeting was held on the same day, at which a report was given about a social function that had been held on August 10 and plans were made for the establishment of permanent committees to take care of programs and speakers for future meetings.

A meeting held on September 12 was addressed by Carl Guldberg, of the Stinson Aircraft Division of Consolidated Vultee Aircraft Corporation, on the subject "Problems in Design."

Power plant Research UP where it Counts

To provide adequate power plant data for plane manufacturers and operators, Wright Aeronautical tests its Cyclone engines under all flight conditions. Special instrument ships such as this flying laboratory enable Wright Aeronautical to gain experimental data today under conditions duplicating those of tomorrow's regular flights.

This Test Equipment Gives Detailed Data

- Test coordinators: pilot and co-pilot.
- Volume meter measures fuel consumption at any given throttle and mixture setting.
- Flight observer at temperature recorder. Instrument records one temperature reading every two seconds.
- Test lines to Wright Cyclone (cowling cutaway to show installation).
- Radio-equipment bay (cutaway to show interior).
- Flight observer interprets oscilloscope pattern of cathode ray detonation detector.
- Panel of 35 instruments, including 6 pressure gauges and 6 valves which can be varied to give 36 additional readings in inches of H_2O.
- Flood lights on instrument panel.
- Photo Panel Observer. Automatic 35 mm. camera takes simultaneous reading of 35 instruments.
- Low-pressure oxygen system.

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FIRST IN FLIGHT
Wright Aeronautical Corporation • Paterson, New Jersey, U. S. A.

At a technical meeting on September 19 the speaker was Mr. Cooper, of the Aeronautical Medical Research Division of the Willow Run Bomber Plant, who spoke on "High Altitude Flight and Its Effects on Pilots and Crews." The Army Signal Corps' film *High Altitude Flight* was shown. Permanent committees were appointed for programs, membership, and activities.

University of Oklahoma

A joint meeting of the University of Oklahoma Student Branch was held with the local chapter of the General Engineers on September 17. Professor Tappen of the Faculty gave a talk about "Cryptograms and Secret Codes."

Spartan College of Aeronautical Engineering

A new Chairman of the Student Branch was elected at a meeting on September 8 to take the place of Egbert F. AuYong, who resigned his chairmanship. J. W. Alldredge was elected as the new Chairman and J. A. Phillips was elected Secretary to succeed Mr. Alldredge in that office. M. Johnson was appointed to the post of Assistant Program Chairman.

A short business meeting took place on September 22, at which it was decided to hold meetings on alternate Saturdays if possible. The Chairman, J. W. Alldredge, outlined the privileges available to members who joined the Library of the Institute and invited all members of the Student Branch to join the Library.

University of Texas

At a technical meeting on September 4 the films *Building of the Consolidated Record Breaker* and *The P-38* were shown. It was announced that subscriptions for the Institute publications were available to Student Members.

At a technical meeting on September 18 the films *The Fight for the Sky* and *The Dizzy Pilot* were shown.

Virginia Polytechnic Institute

On September 11 a technical meeting of the Student Branch was held. The films *Working on Air* and *Power by Wright* were shown.

News of Members

Edward C. Borchers has joined the Sales Staff of the Scientific Glass Apparatus Company.

Edmund W. Coates, of the de Havilland Aircraft Company, Ltd., has been elected an Associate Fellow of The Royal Aeronautical Society.

Walter M. Davies has joined Globe Aircraft Corporation as Wing Design Engineer.

Col. Frederick T. Davison, formerly Assistant Secretary of War for Air, has been promoted to the rank of Brigadier General.

Richard H. Depew, Jr., formerly Manager of Special Projects of the Fairchild Aircraft Division of Fairchild Engine and Airplane Corporation, has been appointed Chief of the Aircraft Disposal Section, Office of Surplus Property, Reconstruction Finance Corporation.

William F. Durand has retired from his wartime work as a member of the National Advisory Committee for Aeronautics. In accepting Dr. Durand's resignation, President Truman cited his distinguished service throughout the period of the war.

Einar H. Einarsson has joined Transcontinental & Western Air, Inc., as Junior Engineer.

Ken Ellington has been appointed Director of Public Relations of Republic Aviation Corporation.

Norvin E. Erickson is now Installations Staff Engineer with Bell Aircraft Corporation.

Andrew Fejer has joined Packard Motor Car Company as Compressor Research Engineer.

Zay Jeffries, Vice-President in charge of the Chemical Department of General Electric Company, has received the 1946 award of the John Fritz Medal for "leadership in the solution of problems affecting the production, conservation, substitution, and scientific appraisal of metals and alloys."

William N. Gardner has been appointed to the Staff of the Langley Memorial Laboratory of the N.A.C.A. as an Aeronautical Engineer.

Myron L. Gossard has joined the Faculty of the University of Illinois as Special Research Associate in Theory and Applied Mechanics.

Earl J. Hicks is now in the Structures Department of Beech Aircraft Corporation.

John V. Holman was awarded an Honorary Polish Pilot's badge by the Commander-in-Chief of the Polish Air Force.

John W. Hoover has been appointed Major Layout Engineer at Globe Aircraft Corporation.

Richard B. Hulett has joined Curtiss-Wright Corporation as Senior Aerodynamicist.

Francis W. Hutchinson has been appointed to the Faculty of Purdue University as Professor of Mechanical Engineering.

Robert J. Krieser has been appointed Aeronautical Field Service Engineer and Technical Writer at Conners-Joyce Company.

Edmund V. Laitone has been appointed Section Head of the Flight Research Engineering Department, at the Research Laboratory of Curtiss-Wright Corporation.

Donald C. Larson is now an Aerodynamicist in the Applied Physics Laboratory of Johns Hopkins University.

Jerome Lederer, Chief Engineer of Aero Insurance Underwriters, has been named Aeronautical Engineering Consultant to the Aviation Section of the New York Board of Trade.

Wilton G. Lundquist, who has been directing the development of an aircraft gas-turbine engine for Wright Aeronautical Corporation, has been named Chief Engineer of the Corporation.

Tieh-Cheng Ning has joined the Fairchild Aircraft Division of Fairchild Engine and Airplane Corporation, to assist in sales promotion of the C-82 Packet.

Bowman R. Otto, President and General Manager of Otto Aviation Corporation and President of the New Jersey Aviation Trades Association, has been elected to the additional office of President of the Feeder Airlines Association, for the coming year.

Oliver L. Parks was elected a Vice-President of the Feeder Airlines Association.

Harold H. Patton is with the Harvey Machine Company as a Project Engineer.

Col. Donald L. Putt has been assigned as Deputy Commanding General, Intelligence (T-2) of the Air Technical Service Command.

Ernest R. Reff has been advanced to the position of Chief Structures Engineer of the Stinson Division of Consolidated Vultee Aircraft Corporation.

Herman Rubin has joined Republic Aviation Corporation as Stress Analyst.

Frederic J. Schaettler is now with American Airlines, Inc., as an Engineer.

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Another of the world's big air fleets to standardize on AC Spark Plugs is the Great Silver Fleet of Eastern Airlines.
The tradition of utmost reliability that has built up around these AC Ceramic Aircraft Spark Plugs had its beginning in World War I, when AC produced the world's first and only successful ceramic spark plugs for Liberty engines. Following that, came AC participation in the triumphs of record-breakers,—Lindbergh, Acosta, Maitland and Byrd —last year the Constellation, this year the C-97, both setting new transcontinental records. And throughout World War II, AC Ceramics have fired the engines of countless Allied fighters and bombers.
AC pioneering has made ceramic aircraft spark plugs what they are today, just as it has given AC's outstanding performance in automotive fields. That's why leading air lines choose AC's for utmost reliability.
AC SPARK PLUG DIVISION • GENERAL MOTORS CORPORATION
LET'S FINISH THE JOB — BUY VICTORY BONDS
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AIRCRAFT
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PLUGS

Major Rudolph W. Schroeder recently received a belated award of the Distinguished Flying Cross for "distinguishing himself by heroism and extraordinary achievement while participating in aerial flights from September, 1918, to February, 1920."

Lloyd H. Sloan has been advanced to the office of Engineer in Helicopter Design, with Jet Helicopter, Reg'd., of Montreal.

Richard M. Springer has joined the Aircraft Gas Turbine Division of Westinghouse Electric Corporation as Flight Test Engineer.

Harry A. Sutton, formerly with Consolidated Vultee Aircraft Corporation, has been appointed Assistant to the Vice-President of Engineering of The Glenn L. Martin Company.

Philip B. Taylor, who resigned as Vice-President and General Manager of Wright Aeronautical Corporation in June, 1945, is conducting a survey of combustion turbines for Pan American World Airways, in his capacity as Consulting Engineer for that company.

Harley M. Thorson has been commissioned a Second Lieutenant in the U.S. Army Air Forces and assigned as Flight Test Maintenance Officer.

George H. Tweney has been advanced to the permanent rank of Assistant Professor at the University of Detroit.

Raymond Vachss has joined Republic Aviation Corporation as an Aerodynamicist.

Meredith C. Wardle is now Chief of Structures at Bellanca Aircraft Corporation.

John D. Waugh has joined the Sales Department of Aeromatic Aircraft Propellers, Bartlett-Hayward Division of Koppers Company, Inc.

Richard J. White is now Senior Aerodynamicist with Boeing Aircraft Company.

Robert O. Wickersham has been appointed Professor and Head of the Aeronautical Engineering Department of West Virginia University.

George M. Williams, who has been on leave of absence as President of Russell Manufacturing Company since December, 1941, to serve as Senior Vice-President of Curtiss-Wright Corporation and Executive Vice-President of Wright Aeronautical Corporation, has returned to his former office.

Shao W. Yuan has joined the staff of Polytechnic Institute of Brooklyn, to continue research work on the helicopter and to introduce an academic course in helicopter engineering.

Members Elected

The following applicants for membership or applicants for change of previous grades have been admitted since the publication of the list in the last issue of the REVIEW.

Elected to MEMBER Grade

Crandall, Ronald Edward, Asst. Group Leader, Consolidated Vultee Aircraft Corp.

Duguid, Hugh Alan, Project Engineer, Sikorsky Aircraft Div., United Aircraft Corp.

Hackett, Virgil Wayland, B.S. in M.E.; Chief Draftsman, Cessna Aircraft Co.

Krebs, Alfred Nelson, B.S. in M.E.; Vibrations Engineer, The Glenn L. Martin Co.

McDaniel, Keith Kendrick, Group Engineer, Boeing Aircraft Co.

Milliken, William Franklin, Jr., M.S. in Ae.E.; Asst. Mgr., Flight Research Div., Research Lab., Curtiss-Wright Corp.

Muzik, Victor Klifton, M.E.; Experimental Engineer & Stress Analyst, Lear, Inc.

Rentzel, Delos Wilson, President, Aeronautical Radio, Inc.

Romans, Theodore, Major Layout Draftsman, Republic Aviation Corp.

Ross, Leslie Joseph, B.S.E.; Chief Consulting Engineer-Adm., Western States Flying Service.

Smith, John Rockwell, B.S. in C.E.; Planning Engineer, Pan American Airways, Inc.

Wanner, Richard, B.Ae.E.; Aerodynamicist, Boeing Aircraft Co.

Winter, Robert Sol, B.S.; Engineering Designer, Consolidated Vultee Aircraft Corp.

Elected to Industrial Member Grade

Albright, James Albert, General Foreman, Flight, Eastern Aircraft Div., General Motors Corp.

Hammond, Charles Edward, Manufacturing Engineer, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

Elected to Technical Member Grade

Adler, Alfred Aron, B.S. in M.E.; Mechanical Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Cederborg, Gibson Ames, B.M.E.; Mechanical Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Franklin, Elmer Sherwood, M.S. in Ae.E.; Lt., U.S.N.R.

Phillips, Manny Woodrow, B.S Lt., U.S. Army Air Forces.

Pond, LeRoy Yates, Sr. Civilian Inspector, Assembly and Repair Dept., Dallas Naval Air Station, U.S. Navy.

Seebol, Robert Leon, Edo Aircraft Corp.

Shideler, Raymond Henry, B.S. in M.E.; Jr. Engineer, Pan American Airways, Inc.

Winson, Jonathan, M.S. in Ae.E.; Aerodynamicist, Kellett Aircraft Corp.

Transferred from Student to Technical Member

Bedell, Eugene James, B.M.E.; Development Engineer, Goodyear Tire & Rubber Co.

Berkery, Thomas Francis, II, B.M.E.; Engineer, Grumman Aircraft Engineering Corp.

Bolton, Duncan Gardner, B.S.; Mechanical Engineer, E. I. du Pont de Nemours & Co., Inc.

Daniels, Robert Louis, B.M.E.

Ellison, Carroll William, B.S. in Ae.E.; Ensign, U.S. Navy.

Foss, Richard Leander, B.S. in Ae.E.; Midshipman, U.S. Navy.

Gibson, Charles Edward, M.S. in Ae.E.; Naval Commander, Naval Aviator, U.S. Navy.

Hadley, Gordon Clifford, B.Ae.E.; Plant Layout Engineer, Fleet Aircraft Ltd. (Canada).

Hawkins, Wallace Kent, B.S. in Ae.E.; Aero. Engineer, Grade P-1, Aircraft Engine Research Lab., N.A.C.A.

McDonough, Brian Dean, B.S. in Ae.E.; Lt. (j.g.), Aircraft Engineering Officer, U.S. Navy.

Palumbo, Ralph D., Jr., Aero. Engineer, The Glenn L. Martin Co.

Schindel, Leon H., B.S.; Midshipman, U.S.N.R.

Smith, Rodney Hobson, S.M.; Staff Member, Massachusetts Institute of Technology.

Weiss, Stanley Irwin, B.Ae.E.; U.S. Navy.

Williamson, Merritt Alvin, M.S.; Lt. (j.g.), U.S. Navy.

Woodruff, Edward Charles, Jr., Engineer, The Glenn L. Martin Co.

Zabriskie, Jesse Henry, M.S.; Major, U.S. Army Air Forces.

Necrology

William Henry Clark

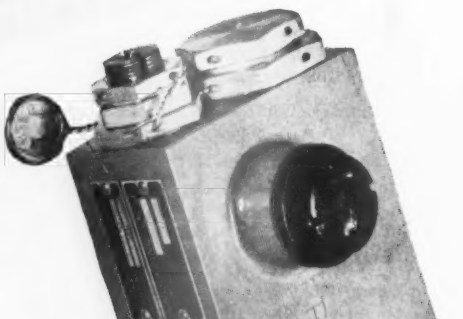
William Henry Clark, an Industrial Member of the Institute and President of the Alox Corporation of New York, died on April 25. News of his passing has only recently reached the Institute.

A native of New York, where he was born September 14, 1886, Mr. Clark was educated in the New York public schools, attended Beloit College, and received the Bachelor of Arts degree from Hobart College. He also studied law at New York University. In connection with his executive duties as President of the Alox Corporation, he collaborated extensively in research work in the field of airplane lubrication and anticorrosive materials.

Sayers Coe

Sayers Coe, an Industrial Member of the Institute and Production Manager of the magazines *Aviation, Aviation News,* and *Air Transport,* died in May, 1945.

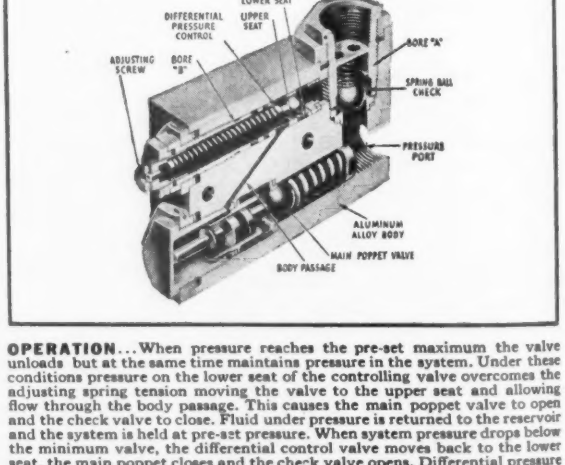
unfailing pressure regulation



ELECTROL'S UNLOADING VALVE

Battle-tested on Navy bombers and fighter planes the ELECTROL unloader valve offers numerous advantages to the aircraft designer. Weighing only twenty ounces, and selling at a remarkably low price, this rugged valve insures safe operation of remote units by maintaining working pressure in the system, relieving the engine-driven pump of this duty. Unloading pressure is adjustable. Through an ingenious system of valves the unit automatically cycles to load and unload, always maintaining the system at the pre-determined state of equilibrium. Construction is to ELECTROL high standards of reliability and performance.

ELECTROL unloader valves are available in six settings ranging from 1,000 to 1,500 lb. per sq. in. Loading pressures range from 800 to 1,250 lb. per sq. in. Specialized requirements can be met by slight modifications. Consult ELECTROL engineers when you design your hydraulic control circuits.



OPERATION...When pressure reaches the pre-set maximum the valve unloads but at the same time maintains pressure in the system. Under these conditions pressure on the lower seat of the controlling valve overcomes the adjusting spring tension moving the valve to the upper seat and allowing flow through the body passage. This causes the main poppet valve to open and the check valve to close. Fluid under pressure is returned to the reservoir and the system is held at pre-set pressure. When system pressure drops below the minimum valve, the differential control valve moves back to the lower seat, the main poppet closes and the check valve opens. Differential pressure is determined by comparative areas in bore "B." Maximum pressure is determined by adjustment screw setting.

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ELECTROL
HYDRAULICS

Mr. Coe was born at Newark, N.J., January 11, 1891. He was graduated with the Bachelor of Letters degree from Princeton University in 1912. He started his business career as Assistant Editor of the *Mentor* in 1912 and from 1917 until 1921 he was Business Manager of the magazine *Town and Country*. He was employed by the investment firm of Toby and Kirk from 1921 to 1925, and acted as an Account Executive with Doremus & Company from 1925 to 1930. Between 1930 and 1933 he was a partner in the firm of Donahue & Coe, Inc., and from 1933 to 1942 he was Eastern Manager of the *Chicago Journal of Commerce*. His connection with the magazines of McGraw-Hill Publishing Company, Inc., continued from 1942 to the date of his death.

Col. Carl Franklin Greene, U.S.A.

Col. Carl Franklin Greene, a Member of the Institute and Liaison Officer of the Air Technical Service Command, stationed at Langley Memorial Aeronautical Laboratory of the N.A.C.A., died at the station hospital at Langley Field on September 13.

Colonel Greene was born at Kitchener, Ont., March 10, 1887. He was educated at Purdue University and Columbia University, and subsequently studied at the School of Military Aeronautics at the Massachusetts Institute of Technology, the Army Pilot School, the Air Corps Engineering School, and the Air Corps Tactical School. From 1907 to 1916 he was engaged in various engineering activities with industrial companies and with the New York Municipal Railway Corporation. He had charge of the structural design work for several sections of the New York municipal subway system.

He entered the Army in 1916, serving as a Corporal with the New York National Guard on duty at the Mexican border prior to the first World War, was commissioned a Lieutenant in the U.S. Army Air Corps in 1917, and served in the Army throughout the remainder of his career. His duties comprised design, development, procurement, and repair of military aircraft, with increasing responsibilities and advancements in rank, serving as Assistant Chief Engineer and later as Commanding Officer at the Air Depot, and as Chief of Structures Unit and of the Aircraft Branch of the then Matériel Division of the Army Air Forces.

In 1930 Colonel Greene was assigned as Commanding Officer of the Air Depot at Luke Field, Hawaii, returning to Wright Field in 1933. He was credited with contributing to the development of the pressure cabin, the internally braced wing, the tricycle landing gear, and other aircraft advancements. His research work was recognized by an award of the Collier Trophy, the Soldier's Medal, and the Distinguished Flying Cross.

Capt. Randolph Hartley

Capt. Randolph Hartley, an Industrial Member of the Institute, died on September 21 as a result of injuries received in an aircraft accident while in the service of his country.

Captain Hartley received his early education in Pittsburgh, where he was born on September 7, 1903; attended a West Point preparatory school; and was graduated in Artillery Engineering from the U.S. Army school at Fort DuPont, Delaware, in 1925. From 1930 to 1938 he performed duties of increasing responsibilities, ranging from riveting work to final assembly inspection with Consolidated Vultee Aircraft Corporation, Boeing Airplane Company, The Glenn L. Martin Company, North American Aviation, Inc., and Lockheed Aircraft Corporation. In 1938 and 1939 he was Assistant Chief Inspector of aircraft construction and procedures at the Aeronautical Institute of Technology at Los Angeles, and in 1939 and 1940 he was Chief Inspector at Timm Aircraft Corporation and at Hardman Aircraft Products, Inc. He was the author of *Hartley's Aeronautical Dictionary and Reference Library*, and *Aircraft Sheet Metal Construction*, in addition to various other treatises and papers on aeronautical engineering subjects.

Lt. Col. Harold Evans Hartney

Lt. Col. Harold Evans Hartney, a Member of the Institute and an aviation consultant, died as a result of a heart ailment at his home in Washington on October 5.

He was born in 1889 and was educated at the University of Toronto and the University of Saskatchewan, receiving the degree of Bachelor of Arts. In October, 1915, he joined the Royal Flying Corps and in 1917 transferred to the American air services with the rank of Major. He served with the 27th Aero Squadron and other organizations throughout the first World War, receiving numerous honors and awards for his military achievements in aviation. He returned to the United States in 1918 with the rank of Lieutenant Colonel and successively held positions as Acting Chief of Operations and Chief of Civil Affairs, resigning from the Army in October, 1921. He engaged in airplane racing and exhibition flying in the period following World War I, serving as technical adviser to various aircraft manufacturers and air-transport companies and other organizations related to the business of aviation. From 1935 to 1939, Colonel Hartney was Technical Adviser for the Senate Air Service Committee and for the Civil Aeronautics Administration. He was recalled to active service in the Air Forces in 1941, was retired to inactive status shortly thereafter, and since that time has acted as Technical Adviser to the Sikorsky Aircraft Division of United Aircraft Corporation, Pennsylvania-Central Airlines, and others.

Personnel Opportunities

This column is for the use of individual members of the Institute seeking new connections and organizations offering employment to aeronautical specialists. Any member or organization may have requirements listed without charge by writing to the Secretary of the Institute.

WANTED

Aerodynamicists and Thermodynamicists—Research minded and with good theoretical background, to engage in research work on high-speed and jet propulsion developments, advanced degrees preferred. Salary commensurate to qualifications. Replies will be held in strict confidence. Write, giving education and experience, to Curtiss-Wright Corporation, Research Laboratory, Buffalo, N.Y.

Aeronautical Engineering Professor to teach Airplane Design, Airplane Structure, and related subjects. Applicants required to have a degree in aeronautical engineering as well as practical experience in the field. Preference given to candidates having advanced degrees. Facilities now under construction and plans for future construction will provide ample opportunity for research, development, and consultation. Rank and salary will depend upon training and experience of applicant. In applying please give brief sketch of personal qualifications, education, and experience. Address reply to Prof. Robert M. Pinkerton, Department of Aeronautical Engineering, A. & M. College of Texas, College Station, Texas.

Aerodynamicists, Stress Analysts, Design Engineers, Detail, and Layout Draftsmen needed for development work on new experimental Military and Commercial model airplanes as well as other related projects of a "Confidential" nature. Curtiss-Wright has several excellent opportunities for qualified personnel. Address inquiries to Curtiss-Wright Corp., Airplane Division, Buffalo, N.Y., Attention: G. A. Page, Director of Engineering.

Aircraft Engineers—Immediate, permanent openings for aircraft engineers with 5 years' experience in

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Spring

The Simmonds-Hobson Automatic Engine Control is made in America by Simmonds Aerocessories, Inc.

The Automatic Engine Control, that gave America the world's fightingest planes, might never have been completed.

AUTOMATIC ENGINE CONTROL is an amazing mechanism. Acting as a third hand for the pilot it relieves him of the constant manual manipulation necessary to keep manifold pressure and mixture set correctly as he changes speed and altitude. By automatically maintaining a pre-selected setting throughout climb and descent, it assures full rated power output, prevents "over-boost" and burned out engines.

Previously, the constant manual adjusting of engine controls demanded a great proportion of the pilot's time during vital altitude changes in combat flight. Even so, he could make only intermittent and approximate adjustments. His attention was constantly diverted from his job of fighting. His vulnerability to surprise attack was high.

Experts claim that if automatic engine controls had been generally available for Allied fighter planes during the Air-battle of Germany, fighting efficiency would have been so increased that bomber losses might have been reduced as much as 50%.

British fighters that were so equipped made such a remarkable showing that engine control became a hot "must" for our Army.

Production schedules were set up even before design problems were licked. Planes and engines were built. An improved control unit was developed—but when it came to the coil spring that actuates and balances its operation, nobody could be found to make it.

This spring, a vital part of the control mechanism, was required to exert, over every point of its functional range, an exact and unvarying pre-set inch-pound loading. In addition, it had to fit already predetermined and very close space limits.

Our well known spring engineering ingenuity was called upon to overcome this intricate spring problem. Today, we are the main source of supply for this important spring program.

It is this faculty for doing the seemingly impossible—for combining with the fine art of spring design, unusual technical and manufacturing facilities—that we put at your disposal for the solving of your spring problems, no matter how exacting.

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aerodynamics, structural design, and C.A.A. airworthiness requirements with Southern California aircraft manufacturer. Air-mail qualifications and recent photo to P.O. Box 29, Burbank, Calif.

Detail and Layout Engineers, Stress Analysts, Aerodynamicists, and Design Engineers—For development work and production engineering work in Engineering Division. Call in person or write to Chief Administrative Engineer, Boeing Airplane Company, Wichita, Kan.

Radio, Electronic and Telephone Engineers, Electronic and Mechanical Draftsmen—One of the largest manufacturers of a wide variety of electronic and communications equipment in the world is fully prepared and ready with an ambitious postwar program. Write to Personnel Manager, Federal Telephone & Radio Corp., 591 Broad Street, Newark, N.J.

Aeronautical Engineer—To teach Senior year subjects of aeronautical engineering course including design and stress analysis. Address inquiries to The Aeronautical University, Inc., 116 South Michigan Avenue, Chicago, Ill.

Aeronautical Engineers—for immediate and urgent top priority work, the long-established Aeronca Aircraft Corporation seeks Project Engineers, Stress Analysts, Weight Engineers, and Layout Draftsmen. Since Aeronca's postwar plans are complete, with peacetime production in the offing, these positions offer unusual permanent opportunities for qualified men who can comply with W.M.C. requirements. Write in complete detail to Aeronca Aircraft Corporation, Box 00, Middletown, Ohio.

Aircraft Stress Engineers thoroughly familiar with the analysis of aircraft structures, aircraft controls, and all component parts for work on helicopters. Excellent opportunities for personnel interested in rotary-wing aircraft. Apply by letter, giving references, to Administrative Engineer, Kellett Aircraft Corporation, Plant #2, Lansdowne Avenue above State Road, Upper Darby, Pa.

Personnel Needed—Executive and Administrative experience in manufacture of aircraft. Positions available in several fields; Factory and Production Management, Matériel, Tooling and Engineering. McDonnell Aircraft Corporation, Ambassador Building, St. Louis 1, Mo.

Project Engineer—Experienced and talented design man to undertake the responsibility for a new aircraft project from inception to completion. Plant located on eastern seaboard. Salary scale above average. Write full particulars. Address inquiries to Box 370, Institute of the Aeronautical Sciences.

Works Manager—Manufacturing executive to set up and operate a production program on a new aircraft. Will direct Manufacturing, Facilities, Inspection and Procurement Departments. Salary scale above average. Located on eastern seaboard. Write full particulars. Address inquiries to Box 369, Institute of the Aeronautical Sciences.

Airplane Salesmen—Large established producer of personal aircraft seeking several qualified airplane salesmen with both flying and merchandising experience. Interview in New York. Address inquiries to Box 362, Institute of the Aeronautical Sciences.

Assistant Sales Manager—Large established producer of personal aircraft seeking qualified assistant sales manager. Interview in New York. Salary commensurate with ability. All replies treated confidentially. Address inquiries to Box 361, Institute of the Aeronautical Sciences.

Associate Professor of Aircraft Structures—To teach senior and graduate courses in aircraft structural theory, develop structures laboratory, and direct graduate structural research work. Practical experience necessary. Advanced degrees preferred. Permanent position. Leading State University. Location—Midwest. Address inquiries to Box 340, Institute of the Aeronautical Sciences.

Associate or Full Professor: To teach advanced courses and direct research in the Aircraft Power Plant Design field. Recent experience in turbine and jet engine design and testing necessary. Advanced degrees preferred. Permanent position, large mid-western university. Can wait six months if necessary. Address inquiries to Box 339, Institute of the Aeronautical Sciences.

Assistant or Associate Professor of Aerodynamics—Young man with Ph.D. to teach graduate courses in theoretical aerodynamics and direct theoretical and experimental research in this field. Research experience necessary. Position permanent. Mid-western State University. Address inquiries to Box 338, Institute of the Aeronautical Sciences.

Associate or Professor of Aerodynamics—To teach performance, control, stability and develop correlating flight test and flight instrumentation courses for large mid-western university. Position permanent. Practical experience necessary. Advanced degrees preferred. Address inquiries to Box 337, Institute of the Aeronautical Sciences.

Aeronautical Engineer—With experience in structures and stress analysis and the writing of reports for submission to the Civil Aeronautics Administration. Address inquiries to Box 326, Institute of the Aeronautical Sciences.

Patent Engineer—Familiar with patent disclosures and procedures. Essential helicopter industry. Salary commensurate with experience and present earning capacity. Address inquiries to Box 322, Institute of the Aeronautical Sciences.

Assistant Professor—To teach Mechanics, Strength of Materials, and Physics in a small Mid-western College. Must have Master of Science Degree, preferably in Engineering or Physics. Salary dependent on qualifications and experience. Position permanent. Address inquiries to Box 291, Institute of the Aeronautical Sciences.

Draftsmen—Four or five, wanted by large research and development organization; experienced in the layout of aircraft structural members. Four or five years' experience required; knowledge of stress analysis desired. Experience in wing or fuselage group would prove satisfactory. Address inquiries to Box 282, Institute of the Aeronautical Sciences.

AVAILABLE

Technical Administration or Technical Sales—Over 20 years of aircraft experience which has covered airplane project design followed by ten years of technical administration work in the top management of two large airplane companies. Wishes responsible position in connection with technical sales. Address inquiries to Box 387, Institute of the Aeronautical Sciences.

Engineer-Executive—Twelve years' experience includes airplane design, stress analysis, and structures. Director of Aeronautical Engineering and Sales in aircraft accessories field. Wide acquaintance in the industry, including manufacturers, air lines, aircraft distributors, A.A.F., and Navy Bureau of Aeronautics. University graduate and professional aeronautical engineer. Seeks permanent connection as a key personnel in design, executive, or sales engineering, or as manager in the aviation department or technical adviser in nonaviation industry. Development and experimental work welcome. Address inquiries to Box 386, Institute of the Aeronautical Sciences.

Administrative Engineer—Graduate engineer with over 15 years' experience in design, research, and manufacturing. Eight years' experience in the administration of a division of engineering of a well known aircraft company. Desires a position of responsibility with a medium sized company that has good prospects for future advancement. Address inquiries to Box 385, Institute of the Aeronautical Sciences.

Engineer—B.S. in Aeronautical Engineering, licensed airplane mechanic, four years' experience. One year on

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THE GLEAMING NEW CARS are things of beauty—as good-looking as they are welcome. But in the long run *performance* counts, and harness-type wiring systems wrapped in VINYLITE plastic tape are far safer and eminently more reliable than older types of assemblies. Made by New England Tape Co., Inc., this unique tape was used on the multiple circuit harnesses of almost every American combat vehicle and service truck—*for eight outstanding reasons.* It is non-flammable and has high dielectric and tensile strengths. Besides exceptional resistance to abrasion, it is virtually unaffected by chemicals, moisture, oils, or grease.

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Specify VINYLITE plastic tape as your best assurance of safety, dependability—and economy—in wiring harnesses. VINYLITE plastics are also available as extrusion materials for primary insulation, tubular jacketing, and conduits, and bring new standards of service and service life in automotive applications. Write Department 12-S for Booklet W-4, "VINYLITE Plastics Wire and Cable Insulation," which will be gladly sent upon request.

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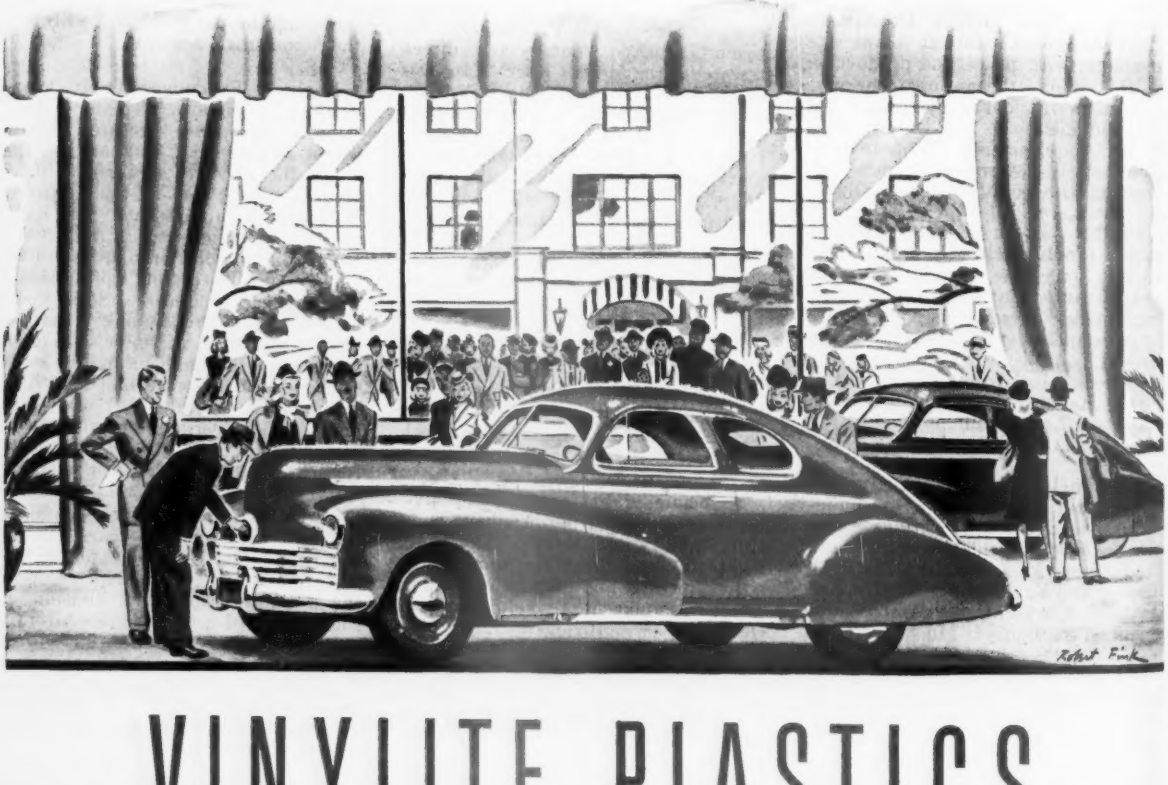

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aircraft design and development. Three years as research engineer on aircraft and other types of internal combustion engines. Chinese with good knowledge of language. Desires a responsible position in China in engineering, engineering sales, or as a technical representative in the aviation, oil, or automotive industry. Excellent references. Address inquiries to Box 384, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.S. in Ae.E. (Mexican Citizen) Speaks and writes Spanish. Desires position with a small company with good opportunities for advancement. Any location in the United States would be considered. Would also consider a position in Mexico as a representative of a company with business relations in this country. Address inquiries to Box 383, Institute of the Aeronautical Sciences.

Structures Engineer—B.S. in Aero. Engineering. Five and one-half years stress experience with the Development Engineering Department of a large Aircraft Corp. Desires responsible position in the Los Angeles area. Address inquiries to Box 382, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Ae.E. Two years' experience as Foreman in Charge of Spinning Aircraft Fabrics, two years in Hydraulics and Contact Work, three and-one-half years as Design Engineer in Aircraft Turret Work, including Design and Layout Work in Armament. Desires position as Sales Engineer or Project Development work. West Coast or Midwest location preferred. Will accept work in Foreign Country. No objection to traveling. Available immediately. Address inquiries to Box 381, Institute of the Aeronautical Sciences.

Aeronautical Engineer—with own design of helicopter having two coaxially counterrotating lift rotors seeks connection with Aircraft Manufacturer. Thirty years' total professional experience including 15 years' airplane, and 2 years helicopter design and development. Address inquiries to Box 380, Institute of the Aeronautical Sciences.

Electrical Engineer—B.S. in E.E., M.S. in E.E., four years' experience coordinating research and development programs aircraft electrical systems. Ten years' design and manufacture electrical equipment. Desires technical administrative position with electrical manufacturer specializing in aircraft. Address inquiries to Box 379, Institute of the Aeronautical Sciences.

Quality Control Manager, Chief Inspector—Eighteen years' aircraft experience. Excellent references. Army or Navy work preferred. Location East Coast. Address inquiries to Box 378, Institute of the Aeronautical Sciences.

Mechanical and Aeronautical Engineer—B.S. in M.E., Aeronautical Engineering Option, 1936. Candidate for M.S. degree in Mechanical Engineering with graduate work to be completed during first year after release from active duty. Two years' experience Machine Tool Design and Drafting; three and one-half years' experience in Aircraft Propeller Design and Vibration Research; one-half year experience in Aeronautical Research; thirty-nine months' service as officer in Army Air Forces Air Technical Service Command's Engineering Division Laboratories and Central District as Project Officer. Highest references. Location near New York City preferred. Address inquiries to Box 376, Institute of the Aeronautical Sciences.

Development Engineer—Graduate Engineer, B.S. in Ae.E., with 6½ years of aircraft and machine design experience, including design of and fabrication contact for varied mechanisms, landing gears, and hydraulic units. Location in Eastern district preferred. Particularly interested in smaller company with expanding post-war plans, in which advancement is possible along with the company. Address inquiries to Box 375, Institute of the Aeronautical Sciences.

Stress Analyst, Design and Development Engineer—B.S. in aeronautical engineering; five years' experience in aeronautical engineering after graduation. Structural design and analysis experience with large manufacturer of military landplanes and seaplanes. More than two years' work in the investigation and development of new structural materials and types of construction including magnesium, plastics, sandwich construction. Experience in latest structural test methods; one and-a-half years' experience as design project officer in Bureau of Aeronautics with engineering cognizance over production and experimental models. Desires permanent position as assistant design project engineer or as structures analytical or test engineer with East or West coast manufacturer. Address inquiries to Box 374, Institute of the Aeronautical Sciences.

Engineer, Development or Chief—Over 25 years on airplane design, accessories development, operations engineering, technical writing, and executive work. Wide experience with all types of materials; inventive and possessing initiative. Recent salary $7,500, but will consider proposition. Eastern part of U.S. preferred but not essential. Address inquiries to Box 372, Institute of the Aeronautical Sciences.

Jet Propulsion Engineer—M.E., M.S. Worked with rockets several years before Pearl Harbor. Asst. Director of Research of O.S.R.D. laboratory where bazooka was developed. Desires contact arms, airplane, or engine manufacturers, and others interested in setting up an independent jet propulsion research laboratory for developing rockets, jets, athodyds. Address inquiries to Box 371, Institute of the Aeronautical Sciences.

Director of Flight Training—Ranking Naval Officer available soon, desires position as Director of Flight Training Program for progressive University. Ten years' teaching, 24 years' aviation. Mechanics, Flight, and Ground Instructor ratings. Organization and operating experience. Address inquiries to Box 368, Institute of the Aeronautical Sciences.

Air-Line Service Engineer—B.S. in Aero. Eng. Over five years with major air line specializing in service problems on some trainers and most types of air transport aircraft. Experienced in troubleshooting, establishing service procedures, etc. Has supervised engineering projects. Desires similar position with small air line or aircraft manufacturer. Address inquiries to Box 367, Institute of the Aeronautical Sciences.

Aeronautical and Structural Engineers—Recently formed engineering organization is interested in contacting aircraft manufacturers to do engineering for entire airplanes or major components. Will assume full responsibility for stress analyses and C.A.A. negotiations. All members of this group have held responsible aeronautical engineering positions in both small and large companies during the last ten years. Address inquiries to Box 366, Institute of the Aeronautical Sciences.

Gear Expert and Mechanical Engineer—Also has considerable aeronautical experience. Fine leadership qualities coupled with analytical mind. M.I.T. graduate. Age 31. Desires responsible position with consulting firm or other organization. Address inquiries to Box 365, Institute of the Aeronautical Sciences.

Administrative Engineer—B.S. in A.E. from University of Michigan. Graduate of Civilian Pilot Training and possesses civilian pilot's license. Also holds an Aircraft Mechanic Certificate. Graduate of an accelerated course in Maintenance Engineering at Yale University. At present Administrative Officer assigned to an Aircraft Maintenance Unit, A.A.F. Would prefer employment by a commercial air line. Will be available within the next four months. Address inquiries to Box 364, Institute of the Aeronautical Sciences.

Engineer—Aeronautical Graduate. Familiar with research of transport aircraft and technical writing. Manufacturing and air-line experience, maintenance and operations. Administrative, writing, and sales ability. Desires position in engineering sales

Portrait of Randolph C. Walker by John Carlton

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AIREON produced huge quantities of communications and radar equipment and other machinery for waging war. Its achievements were equal to its heavy responsibilities, and its workers established an outstanding record of performance.

AIREON enters peacetime production with a notable engineering organization, highly skilled personnel and great confidence in the future. We have developed many products which will contribute to better living, for the manufacture of which all 15 AIREON plants will continue in production.

In order to extend our usefulness we recently established an experimental laboratory in Greenwich. AIREON's creative engineering in radio communications, electronics, musonics and hydraulics will team with production proficiency in contributing devices for future service.

In peace, as in war, AIREON will stand for quality and performance.

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writing or as a technical consultant for aviation or nonaviation industry. Address inquiries to Box 363, Institute of the Aeronautical Sciences.

Aeronautical Engineer—S.B. in Aeronautical Engineering, Massachusetts Institute of Technology. 27 years old. Over 6 years of design and structures experience, desires position with West Coast Aircraft Manufacturer. Available immediately. Address inquiries to Box 360, Institute of the Aeronautical Sciences.

Stress Analyst and Design Engineer—B.S. in Mechanical and Aeronautical Engineering from I.I.T. Have had experience in large eastern aircraft corporation as design engineer since graduation in June. Have had much study in stress analysis in structures and intend working for masters' degree. Desire position in structural design or stress analysis. Any location considered. W.M.C. compliance and draft exempt. Address inquiries to Box 359, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Ten years' experience teaching aeronautics and allied subjects. At present employed by Navy Department in aerodynamic analyses of military aircraft, including considerable work in jet propelled types. Desires a teaching position in the south or southwest by winter or spring term. Address inquiries to Box 358, Institute of the Aeronautical Sciences.

Engineering Service and Sales Representative—Engineering Degree, total of 10 years' aircraft design, accessory and sales engineering, hydraulic and control equipment experience. Extensive contacts, services, aircraft plants, industrial and marine field. Seeking position in engineering or engineering sales or as technical representative in aviation or allied field. Address inquiries to Box 357, Institute of the Aeronautical Sciences.

Aeronautical Equipment and Sales Engineer—Graduate engineer with 14 years' experience in civil and military aviation specializing in the sales and service of aircraft instruments and equipment. Recently released from active service in the Army Air Forces after 6 years devoted largely to pilot training and aircraft and equipment testing. Over 5,000 hours as pilot in military and civil aircraft. Interested in position offering executive responsibilities in the interest of sales and service within this country or abroad. Will consider any position where a broad background in aviation development, initiative, responsibility can be employed. Available for immediate employment. Excellent references. Address inquiries to Box 356, Institute of the Aeronautical Sciences.

Design Specialist—B.S.Ae.E. Ten years' experience private pilot, experimental engine testing, stress analysis, preliminary airplane design, contract administration, responsible for the design and manufacture of numerous engine installations ranging from 165 to 3,000 hp., as well as turbo and turbojets. Excellent background in coordination of production and tooling acquired in capacities of project engineer and design section manager. Widely acquainted in the industry east and west. References based upon accomplishments. Desires affiliation in responsible capacity with progressive engineering organization. Address inquiries to Box 354, Institute of the Aeronautical Sciences.

Industrial Engineer—B.S.M.E. Eleven years' experience in selecting equipment and supervising installations for aircraft manufacturing processes, including experience in production of airplane motors; also twenty-five years' experience in the automotive engineering and production field. In a position to do consulting work as industrial engineer. Address inquiries to Box 353, Institute of the Aeronautical Sciences.

Engineer—B.S. in M.E. Age 27, married, two dependents. Seven years' varied aircraft engine experience. Past positions include Test Engineer, Supervisor of Carburetor Test Laboratory, and Assistant Chief Inspector. Desires engineering position doing experimental research or product development. East Coast preferred. No objection to traveling. Address inquiries to Box 350, Institute of the Aeronautical Sciences.

Development Engineer, A.E. graduate. Experience includes complete development and sales engineering of aeronautical and mechanical accessories and instruments. Background of light plane and military aircraft design. Private pilot. West Coast location preferred. Address inquiries to Box 349, Institute of the Aeronautical Sciences.

Engineer—M.E. Degree (1943). Worked nine months as assistant project engineer on electromechanical devices before entering the Navy. Honorably discharged after service as radio technician. Engaged as aerodynamicist since February, 1945, on jet-propelled aircraft project. Desires position in New York City where experience in electromechanics and aerodynamics can be utilized. Address inquiries to Box 347, Institute of the Aeronautical Sciences.

Tool and Gage Foreman—Past 5 years in designing, planning, and supervising gage manufacture. Experience covers other types of precision tools such as broaches, dies, etc. Previous experience in tool and die work outside of aircraft industry. Thoroughly versed in Tool Steel Heat Treating, Nitrioning Process, Stabilizing, Immersion type and Open Hearth Furnaces. Connected with large aircraft manufacturing plant. Seeking position as Foreman or Assistant Foreman with reliable firm, not necessarily aircraft. Willing to locate anywhere in United States and Possessions. Address inquiries to Box 346, Institute of the Aeronautical Sciences.

Registered Professional Aeronautical Engineer—Has successful consulting practice; would like to represent a responsible aviation corporation or air-line company in the Detroit and lower Michigan area. Graduate degrees from two universities; 8 years' experience as consultant, engineer, executive and professional man. Services could cover all fields such as engineering and sales contacts, technical and professional representative, etc. Permanent appointment with modest monthly retainer fee desired. Address inquiries to Box 345, Institute of the Aeronautical Sciences.

Senior Aerodynamicist—Over 20 years' experience in aeronautics. Excellent theoretical background. Now Research Engineer with big company. Desires permanent responsible position, preferably as Consulting or Research Engineer. Address inquiries to Box 344, Institute of the Aeronautical Sciences.

Aeronautical Engineer—B.S.M.E., University of Colorado; M.S. Aero. Eng., Massachusetts Institute of Technology. Five years' experience: 4 years with A.T.S.C., Engineering Division, Wright Field in Flutter, Aircraft Dynamic Load Measurement, and general development of mechanical and electronic instruments and recording equipment. Desires position in instrument research and development and flight test engineering. Address inquiries to Box 342, Institute of the Aeronautical Sciences.

Helicopter Chief of Structures—Two years' Chief of Structures, Sikorsky Aircraft, formerly Chief Stress Analyst other leading rotowing manufacturer. Licensed professional engineer, New York, New Jersey, Connecticut, Pennsylvania. Twenty years' structural designing background. Address inquiries to Box 341, Institute of the Aeronautical Sciences.

Engineer—B.Ae.E.; M.S. in M.E.; Ph.D.; Aeronautics major. Holds pilot's license and C.A.A. ratings to teach all phases of ground school. Prefers position in industry but will consider a university position with research and consulting possibilities. Location on west coast preferred but not a limitation. Address inquiries to Box 336, Institute of the Aeronautical Sciences.

Research and Development Engineer, B.S. in E.E.; M.S. in Ae.E. Three years' experience in propeller stress analysis, previous experience in electronic equipment and some experience in control mechanism design. W.M.C. compliance. Highest references. Must do essential work. Address inquiries to Box 333, Institute of the Aeronautical Sciences.

Graduate Aeronautical Engineer—Bachelor and Master of Aeronautical Engineering degrees from N.Y.U. Two and one-half years' engineering in aircraft manufacturing and $2^1/_2$

(Continued on page 55)

AiResearch Actuators

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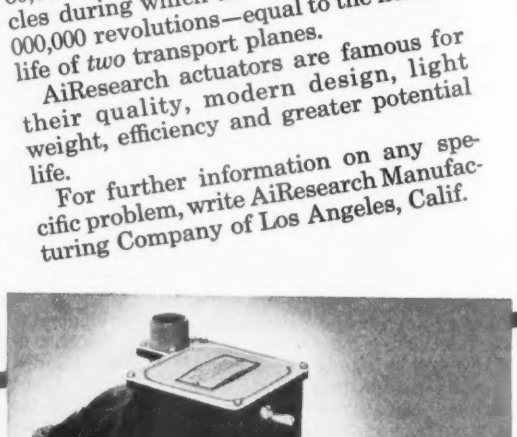
ACTUATORS—AiResearch makes a complete line of electric actuators for military and commercial aircraft—engineering and manufacturing the motors and all component parts. In the last two years 28 different models, which are variations and combinations of 8 basic torque and linear types, have been produced.

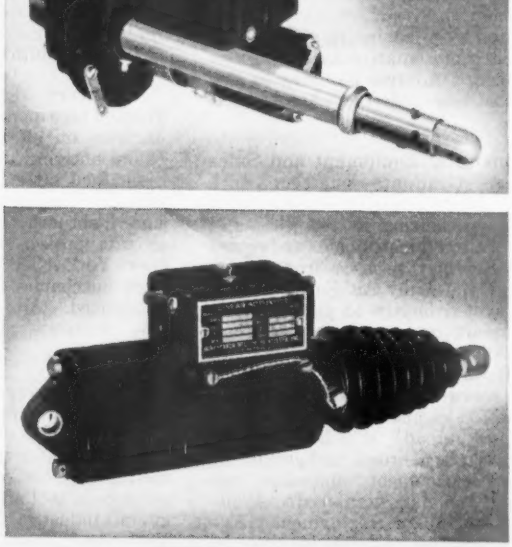
First to build the linear type actuator, AiResearch has recently made another contribution to the development of actuators in a simplified brake which will stop a 10,000 R. P. M. actuator motor in from 4 to 5 turns. *All* AiResearch actuators are relatively trouble free... designed to perform over extremely long life cycles...for they have a great reserve of strength and durability. Ratings of the 8 basic actuators now being built are: 100, 300, 750, 800, 1200, 1600, 2000 and 10,000 pounds.

In tests AiResearch actuators have raised 2000 pounds 10,000 times *without failure*. And they have been run through 60,000 complete, normal operational cycles during which the motor made 300,000,000 revolutions—equal to the normal life of *two* transport planes.

AiResearch actuators are famous for their quality, modern design, light weight, efficiency and greater potential life.

For further information on any specific problem, write AiResearch Manufacturing Company of Los Angeles, Calif.





MOTORS—AiResearch has designed and is now building 400 cycle single and three phase motors for actuators, a unique development in the aircraft field. They range from 1/50 to 1/4 horsepower and are equipped with the newly developed AC brake. Each is small, compact, precision built and designed to operate under extreme conditions, including temperatures ranging from —65 degrees to +165 degrees F.

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National Light Aircraft Meeting

The National Light Aircraft Meeting of the Institute was held on October 4 and 5, 1945, in the small auditorium of the Horace H. Rackham Educational Memorial at Detroit, Mich. The purpose of the two-day meeting was to study problems in design, construction, and operation of personal light aircraft.

Trends of design for the future were discussed and new developments in aircraft radio were described. Stress investigations of materials developed during the war and now available for use in the construction of commercial airplanes were reported. Other papers compared the relative merits of low-wing and high-wing aircraft and investigated the design of their undercarriages. One analysis dealt with the problem of ground vibrations of helicopters.

The complete program of the meeting and the available abstracts follow:

Thursday, October 4, 2 P.M.

Chairman: Arnold M. Kuethe

Professor, Department of Aeronautical Engineering, University of Michigan

Elimination of Direct Reading Compass Errors by Proper Aircraft Design—J. Manildi, G. M. Giannini & Co., Inc.

The earth's magnetic field is affected within the airplane by permanently magnetized iron, by soft iron which exhibits a variable magnetism depending on its position in the earth's field, and finally by electrical circuits.

The sum of the distortions caused by these three sources is considerable in certain airplanes and necessitates the use of remote indicating compasses, the transmitter of which is placed in a location where the magnetic field is least disturbed.

By using certain detail design practices, it is possible to control magnetic conditions in the cockpit so as to obtain a very uniform field and permit the use of a direct reading compass with all the accuracy afforded by a remote compass, and with a resultant economy in weight. This is of particular interest to the small airplane design engineer.

Design data and practice directed to reduce the magnetic distortion are outlined in the paper.

Itinerant Aircraft Radio—H. T. Sagert, Sales Manager, Aviation Radio Division, Lear, Incorporated.

An analysis and review of a subject about which there has been a dearth of authentic information and which, in view of the impetus to postwar itinerant flying, is especially timely.

Relationships between the individual pilot and the type of aircraft, the nature of his flight operations, the selection of his radio and accessories, as well as maintenance and service facilities available are presented.

Explanations readily understood are given on the "whys" and "wherefores" of antenna and power requirements. Electrical and mechanical installation considerations are presented along with suggestions as to the operation and care of the equipment. A simplified explanation of the Federal Communication Commission's requirements of aircraft radio station licenses is included.

A preview of the bright prospects that V.H.F. radio promises to personal aircraft radio balances the paper.

Thursday, October 4, 7:30 P.M.

Chairman: Peter Altman

Consulting Engineer

The Pilot's Case for the Low Wing Monoplane—Ralph H. Upson, Consulting Engineer.

In this paper the pilot's problems are considered as engineer's problems when they are involved with wing location. It is held that the low wing not only provides the personal flyer with better performance for less cost but also has elements of improved safety by reason of superior vision, better crash protection, low center of gravity and other practical advantages in comparison to the high-wing type. Supplementary problems of navigation and control are also considered. It is concluded that the outstanding evidence favors the low wing as the safer, cheaper and better airplane, but that best possible results will be realized only when all airplanes in the personal class can be standardized to that type.

Probable Materials of Construction—Post Reconversion Light Airplane—F. B. Lane, Chief Engineer, Turret Division, Engineering and Research Corporation.

The writer feels that there has been a great deal of discussion of the new light airplanes with a lack of emphasis on new materials and types of construction. A review is made describing the past materials of construction and their present usage.

A stress analysis investigation is then made of the most promising new materials, and aspects of their weight, cost, reliability and maintenance are discussed. The composite wood structure is examined and the difficulty of material control and subassembly fabrication pointed out. From these considerations an attempt is made to determine the most desirable structural materials for the new airplanes.

The conclusion is reached that metal is advisable and that such materials as magnesium sheet for skins are probably desirable. It is further shown that use of thick skins, either magnesium or aluminum alloys, can save cost by eliminating much of the internal bracing and structure. It is argued that the improvements in the use and manufacture of the magnesium alloys made during the war should now be utilized by the light-airplane industry. Proponents of the nonmetallic materials undoubtedly will take issue with some of the conclusions. The paper is not strictly conclusive since the subject is recognized as controversial but it is intended to stimulate discussion of the new materials.

Friday, October 5, 2 P.M.

Chairman: Walter Jamouneau

Chief Engineer, Piper Aircraft Corporation

Ground Vibrations of Helicopters—M. L. Deutsch, Dynamics Branch, Aircraft Laboratory, Engineering Division, Air Technical Service Command.

The problem of "ground resonance" in helicopters is discussed with emphasis on practical considerations. The theory is briefly reviewed and the results are stated. Formulas are given which enable calculations to be carried out for the center of the range of instability, the critical speeds for fly-wheel type resonance, and the damping required to eliminate the range of instability. Landing gear and blade dampers are discussed and, finally, methods of test are considered.

Compatibility of Roadability and Landing Ability of Undercarriages—Reinhardt M. Rosenberg, Design Specialist, Nashville Division, Consolidated Vultee Aircraft Corporation.

The sprung weight, center of gravity location, mass moments of inertia, and velocity of translation define the dynamic characteristics that are required of an undercarriage from the standpoint of ride comfort in road-borne vehicles.

It is shown how an undercarriage should be designed for ride comfort, and these principles are applied to a fictitious, small airplane of a configuration that is conventional except for a four-wheel undercarriage.

In addition to the parameters named above, the stalling speed, sinking speed, gross weight, and L/D ratio are required to design an undercarriage that is satisfactory for landings.

The undercarriage, designed for ride comfort, is then subjected (analytically) to a landing and investigated for adequacy. It is shown that:

(1) The spring stiffness is insufficient.
(2) The maximum deflection is insufficient.

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(3) The maximum damping permissible for ride comfort is not sufficient to dissipate the energy of the airplane in landing.

(4) The airplane is longitudinally unstable on the ground.

(5) When the nose wheels are steerable in the manner of those of an automobile, and under certain conditions of side wind, the airplane may present a hazard from the standpoint of overturning.

Finally, ways are indicated of combining all requirements in one vehicle. The fact that the vehicle does not have wings (and perhaps tail assembly) in the same position on the ground as in the air may be utilized to effect a shift in the center of gravity. This may achieve longitudinal stability in take-off runs. If, furthermore, the spring suspension is designed for ground travel only, the first of the named incompatibilities disappears. The stroke of the damper will then have to be sufficiently long to absorb the energy of landing in one stroke. In this manner, it may be possible to design an undercarriage that is satisfactory for ground travel as well as for landing.

Friday, October 5, 7:30 P.M.

Chairman: William B. Stout

Graham-Paige Motors Corporation

Control Operation of the Spratt Wing—George Spratt, Nashville Division, Consolidated Vultee Aircraft Corporation.

Simplified Design for Low-Cost Airplanes—Alfred Marchev, President, Republic Aviation Corporation.

By applying the fundamentals of engineering production, the volume production of metal units for aircraft can be simplified and the costs substantially reduced. Through redesigning and retooling, the number of parts for the stabilizer of the Republic "Seabee" Amphibian was reduced from 42 to ten, and in static tests it satisfactorily supported 110 per cent ultimate load. Similar experimental designs of other parts are shown to have resulted in similar economies in production time and cost.

Personnel Opportunities

(*Continued from page 51*)

years' engineering in air-line maintenance and operation. Recently completed engineering and economic studies on major postwar aircraft for air-line operation. Will receive Masters in Commerce and Finance in 2 years. Draft exempt and release available. Excellent references. Address inquiries to Box 332, Institute of the Aeronautical Sciences.

Aeronautical Engineer—Pilot—Graduate engineer over 15 years' experience in design, research, and manufacturing; eight years as experimental test pilot; eighteen years' flying experience. Desires position with company offering postwar future combining engineering and flying. Past employment includes several years as consulting engineer and chief engineer with large company. No objection to traveling. Address inquiries to Box 307, Institute of the Aeronautical Sciences.

Production Executive—Mechanical engineer with five years' administrative experience in all phases of aircraft construction including line assembly methods, tool and jig design, and one year as Director of Experimental. Served ten years as Works Manager of large plant fabricating precision metal parts for automatic actuating mechanisms. Thoroughly familiar with modern precision machine shop practice, serving eight years as Plant Manager. Manufacturing experience totals 26 years. Automotive background. Enjoys a wide acquaintance among subcontractors in central and eastern area. Will travel. Address inquiries to Box 292, Institute of the Aeronautical Sciences.

Plan Now to Attend

Ninth Wright Brothers Lecture

U. S. Chamber of Commerce Auditorium **Washington, D.C.**

Monday, December 17, 1945

Dr. Harold Roxbee Cox, Associate Fellow of the Institute and Fellow and Vice-President of The Royal Aeronautical Society, has been selected as the Lecturer for 1945. His subject will be

British Aircraft Gas Turbines

The lecture will be discussed by leading scientists and engineers.

I.A.S. Honors Night Dinner

Grand Ballroom **Hotel Waldorf-Astoria, N.Y.**

Monday, January 28, 1946

Lt. Gen. James H. Doolittle, Past-President and Fellow of the Institute, will be the guest speaker at the dinner. The complete program of the dinner and of the honors and awards to be presented will be sent to all members of the Institute during December.

Fourteenth Annual Meeting

Columbia University **New York, N.Y.**

January 29, 30 and 31, 1946

The complete program of the technical sessions of the Fourteenth Annual Meeting will soon be available for national distribution.

Members and others planning to attend meetings and dinners of the Institute are urged to make early train and hotel reservations.

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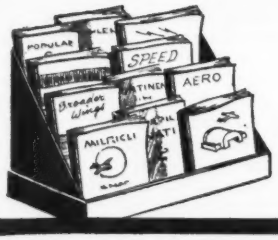

Periodicals

The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Engineering Review or the Institute of the Aeronautical Sciences.

Accessories and Equipment

Payload and Long Range. Sir Alan Cobham's method of transferring fuel from one aircraft to another in flight is detailed. Indicating the value of being able to refuel airplanes in the air, the article gives particulars about the special equipment developed for the Cobham system, as well as about the devices used for safeguarding against accidents during the transfer. The process of refueling in the air is traced through its three stages: the making of contact between the "tanker" aircraft and the "receiver" plane; the transfer of the fuel; and the "breaking away." Attention is called particularly to the means of making contact, stated to be completely reliable, which is effected by firing a sort of line-carrying harpoon from the "tanker" into the curve of a line trailing from the "receiver" plane. *Flight*, August 23, 1945, pages 200–204, 12 illus.

Aerodynamics

Effect of Temperature Lapse Rate on Recovery from Compressibility Dives. C. E. Pappas and M. G. Harrison. It is shown in the main body of the paper that the effect of a temperature inversion may be such as to make recovery from a compressibility dive impossible. Statistical data show that more accidents have resulted from compressibility dives between late November and early May and in northern areas where the ground temperatures might be expected to be low. Because of the airplane's high speed and high wing loading, a Mach Number is reached in the dive where the airflow adjacent to the airfoil breaks down and there develops what is known as a compression shock. It is proved that the Mach Number depends only on the equivalent air speed and pressure. For a constant value of drag and C_L, the Mach Number is a function of the pressure only. Airplane inertia effects are shown to be an important consideration in determining the Mach Number during the dive when temperature inversions occur. Charts are included to enable the pilot to determine the Mach Number by knowing the pressure altitude and equivalent air speed. *Journal of the Aeronautical Sciences*, October, 1945, pages 379–384, 9 illus.

A General Stability Index for Flow Near Plane Boundaries. Hunter Rouse. The writer proposes a general criterion for the stability problem in fluid mechanics, in an effort to provide a physical picture of the controlling factors which will be within the grasp of the average engineer. He states that although the stability index proposed does not have the justification of rigorous mathematical derivation and has not evolved from extensive laboratory study, it does stem from logical and almost self-evident dimensional and physical concepts, and its general significance is indicated by experimental data already at hand for several basically different types of fluid motion.

The formulation of the index is explained, with reference to flow in a laminar boundary layer along a flat plate, flow through pipes, and flow between parallel boundaries. In remarks concerning the general significance of the index it is noted that if such additional variables as boundary curvature or density gradient were involved in the problem, the same stability index would then obviously assume the role of a dependent variable, its magnitude for critical conditions becoming a function of the boundary geometry or of either the Froude Number or the Richardson Number. *Journal of the Aeronautical Sciences*, October, 1945, pages 429–431, 1 illus.

The Aerodynamic Performance of Small Spheres from Subsonic to High Supersonic Velocities. A. C. Charters and R. N. Thomas. Smooth spheres, $^9/_{16}$ in. in diameter, were fired through a group of photographic stations spaced at intervals along the trajectory. Each station recorded an image of the sphere and of the pattern of the surrounding shock waves. The successive times of operation of each station were recorded on a precision chronograph and were combined with the distances to determine the retardation and, hence, the drag. The firings were carried out at Mach Numbers from 0.29 to 3.96 and at the corresponding Reynolds Numbers from 9.3×10^4 to 1.3×10^6.

The results show that the drag coefficient is essentially constant at sub-

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sonic velocities, rises rapidly through a relatively broad transsonic region, and decreases slowly with further increase in velocity in the supersonic region. At subsonic velocities, the drags agree well with the measurements made elsewhere below the critical Reynolds Number. However, a close examination of drags and separation points showed no evidence of a critical Reynolds Number for this size sphere. It is believed that separation phenomena on small spheres at supersonic velocities are controlled by compressibility effects rather than boundary-layer conditions.

Additional firings were carried out with rough $^9/_{16}$-in. spheres, with smooth $^9/_{32}$-in. spheres, and with smooth $1^1/_2$-in. spheres to study the effects of roughness and size. At supersonic velocities these effects change the drag but little. At low transsonic velocities the drag coefficients of the $1^1/_2$-in. spheres fall well below the $^9/_{16}$-in. sphere curve, and this difference, combined with changes in the wake flow pattern, demonstrates the occurrence of a critical Reynolds Number for the $1^1/_2$-in. sphere. *Journal of the Aeronautical Sciences*, October, 1945, pages 468–476, 9 illus.

Tailless Aeroplane Control Systems. A. R. Weyl. In this further discussion of problems connected with the design of tailless aircraft, the subject of control systems is surveyed. The writer discusses ailerons actuated by sideslip motion, inset controllers, washout and reflexed camber, other aerodynamic controls, and emergency controls. *Aircraft Engineering*, August, 1945, pages 237, 238, 5 illus.

Computation of Compressibility Effect on the Flight Envelope. Squadron Leader H. R. Foottit. A graphical method is proposed for correcting a maneuvering-flight envelope, or "V-g" diagram, to allow for the effects of compressibility. After a brief explanation of the variables that enter into the calculations of load factors, acceleration at altitude, and flight-speed limitations when air speeds approach the compressibility range, the variables are listed as (a) increase of Mach Number with increase of altitude; (b) decrease of lift coefficient with increase of Mach Number; (c) increase of stalling speed with decrease of the lift coefficient; (d) decrease of maximum obtainable load factor with increase of stalling speed.

The explanations are accompanied by equations and graphs. The construction of the graphs is described to show how the maximum load factor for a given airplane can be obtained by reading the curves for any indicated flight speed and altitude. Specific examples are given and conclusions are summarized. *Aero Digest*, September 1, 1945, pages 105, 106, 109, 176, 7 illus.

Air Power

It Must Not Happen Again. V. L. Gruberg. Pointing to lessons that should have been learned from the last postwar era, when Germany by devious methods managed to build up her air power, the writer stresses the need for firm control of German aviation by the United Nations. He outlines some of the economic and social problems involved in exercising such control and offers specific suggestions on ways of achieving that control. Bases of the plans are that all finished and semifinished German aircraft, engines, and accessories be requisitioned by the United Nations; the manufacture of any aeronautical equipment in Germany be prohibited; no training on powered aircraft of any size, no gliders, and no parachute-jumping be permitted; all private-flying activity and private ownership of aircraft or any other airborne equipment be prohibited. The plan also calls for the establishment of an international holding corporation which would be endowed with permanent and exclusive concessional rights for the possession and exploitation of specified German institutions, airfields, and installations. It is proposed that this corporation in addition be responsible for research institutions; the maintenance of ground facilities including meteorologic stations; and for international trunk routes in Germany which might have to be operated in the interests of European economy. *Flight*, August 16, 1945, pages 175–178, 6 illus.

Airpower and the Collapse of Japan. The part played by air power in the war against Japan is traced from the be-

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ginning of 1944 to Japan's final defeat. In addition to outlining actual events that took place, the review gives an account of developments in equipment and techniques, the numbers of the forces and amounts of armament directed against the Japanese, and Japanese losses. It indicates how the air events and the gradual acquisition of more and more air bases followed the Allied overall plan for defeating Japan. Attention is called to the interrelationship between the activities of the Allied air forces and those of their land and sea forces. *Aero Digest*, September 1, 1945, pages 35–39, 188, 191, 192, 6 illus.

Air Transport

4,500 Transports. Lt. Gen. Harold L. George. Claiming that a commercial air-line fleet of about 4,500 transport planes is essential to national security, the Commanding General of the Army Air Transport Command discusses the importance of lowering air-line rates so that such a fleet may be maintained. For the needed volume of travel, he estimates that commercial air carriers would have to provide passenger service at about three cents per passenger-mile and cargo rates of about 30 cents per ton-mile. He also indicates how the rates might be reduced through two basic courses of action: (1) by utilizing to the fullest the airplane's capacity in pay load, as far as is consistent with safety; (2) by careful analysis, on the part of air carriers and aircraft manufacturers, of every factor so as to discover and utilize additional methods of contributing to the economy of air-transport operations. *National Aeronautics*, August, 1945, pages 13, 14, 26.

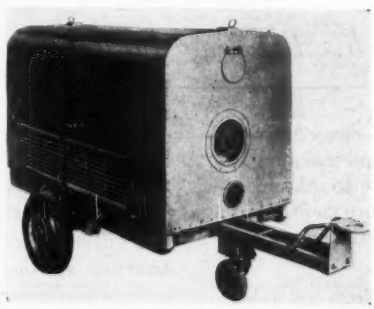
Dehydrated Packaging for Air Transport. Robert D. Goodall. Based on an inspection trip in the Pacific theater of war made by personnel of the Engineering Division of the Air Technical Service Command, data are reported regarding dehydrated packaging for products transported by air. Particular consideration is given to the use of metal containers as moisture-vapor barriers and to the development of barriers and containers that can be reused. It was found that material sent and stored in metal containers using silica gel desiccant for dehydration arrived and remained through a long period of storage in the same condition in which it left the production line. *Aero Digest*, September 1, 1945, pages 122, 125, 187, 6 illus.

The Key to Lower Airline Tariffs. Joseph L. Nicholson. Means of reducing air-transport costs are discussed. It is stated that improved aircraft engines and fuels offer only a partial answer to the question of lower air fares and cargo rates. Lying beyond the control of the designer, yet important in the total cost of transporting passengers and cargo, are ground and indirect expenses. Exception is taken to the use of set percentages of indirect costs in the manufacturer's per-mile cost estimates. Tables show statistical comparisons of costs, tonnage volume, and operating expenses. *Air Transport*, September, 1945, pages 79, 80, 83.

The Crimson Route. Capt. Donald McVicar. Stressing the practicability of the "Crimson" air route across the North Atlantic for commercial purposes, the pilot who pioneered the route tells the story of how it was established. It was secretly established during the war and equipped with navigation aids and airport facilities. The route, a Great Circle one from western Canada to the United Kingdom, is credited with being 1,000 miles shorter than the best alternative way. Using popular airports in western Canada, it proceeds to Le Pas, Man., to Churchill on the west shore of Hudson Bay, and then on across Southampton Island in Hudson Bay, Baffin Land and southern Greenland, to Iceland, and on to Prestwick, Scotland.

A time-and-distance comparison is given of the Crimson route and the conventional route from the west coast of Canada to the United Kingdom. *Canadian Aviation*, September, 1945, pages 44–47, 88, 92, 9 illus.

I.C.A.N. The functions, organizational setup, location, and history of the International Commission for Air Navigation are outlined. An insight is given into the work yet to be done by the Commission before it ceases operations and is merged into the new international body provided for by the Chicago Conference. Functions of I.C.A.N. are summarized as: (1) a council charged with ensuring the application of the Paris Convention of 1919 and its normal evolution by proposing to the contracting States the amendments called for by the development of international air navigation; (2) a kind of international parliament having powers at all times to adapt the technical regulations to the needs of air traffic; (3) a tribunal for settling disagreements that may arise between contracting States with regard to the technical regulations that it has power to enact; (4) an advisory committee giving its opinion on questions that the States may submit for examination; and finally (5) an organization for the collection and dissemination of all information indispensable to airmen. *Flight*, August 30, 1945, page 234.



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The Airlines—In War and Peace. Donald W. Douglas. The President of Douglas Aircraft Company, Inc., reviews the accomplishments of the Air Transport Command, Naval Air Transport Service, Troop Carrier Command, and the civil air lines during the war, and discusses the air-lines' place in peace. Pan American Airways' contributions to air transport are outlined. *Air Transport*, September, 1945, pages 20–25, 12 illus.

Plane Sense and Bush Flying. Part III. Dale S. Atkinson. Continuation of a series of articles analyzing the potentialities, costs, rates, and revenues of an air-transport operation in the northwestern part of Canada. Part III discusses the use of load-charts to examine the effective carrying capacity of an aircraft as a basis for determining rates. Such charts are explained in connection with three aircraft commonly used in "bush" flying, and with weights approved by the Department of Transport. The three airplanes are the Beechcraft 18A, 640-hp. seaplane; the Norseman Mark IV seaplane, 550 hp.; and the Fairchild seaplane, 450 hp. *Canadian Aviation*, September, 1945, pages 68, 70, 72, 4 illus.

Bill Long's "Essair" Line. The history, operations, and plans of the Essair feeder air line are outlined. In addition, brief biographic notes tell about Major William F. Long, head of Essair, and his career in the aviation industry. Established in Texas in 1943, Essair is stated to be the first air line, not in operation when the C.A.B. was created in 1938, to be granted a C.A.B. certificate for air transportation of persons, property, and mail; the first air line to be certificated for intrastate air-transport operation; the first air line to be granted a certificate specifically labeled "feeder line"; and the first recipient of a C.A.B. certificate with limitations for the purpose of improving service at intermediate points. *Aero Digest*, September 15, 1945, pages 42, 111, 1 illus.

New Business Through "Air Trucking." Don M. Kimsey. As presented to the C.A.A., a plan is reported for the establishment of regular feeder lines in agricultural sections of the United States to transport farm products by air. The value of this plan as a business stimulant is pointed out and it is suggested that the transportation of fresh foods by air also opens an additional field for charter aircraft. Actual experiences of sending farm products by air are recounted. *Airports*, September, 1945, page 42, 1 illus.

"He got his training in a ball turret!"

Never before in the history of flying have so many American men and women been trained to build, fly and maintain aircraft. Even discounting those who will move to other occupations during the reconversion period, we have manpower to remain secure in the air, both from a military and a commercial standpoint.

However, other nations also have great air fleets and trained personnel. The question of who will carry the world's air commerce is likely to be the subject of international bargaining for many years to come. The nation which consistently produces planes that can be operated at a lower cost will have an "edge" in such bargaining.

In developing post-war commercial aircraft, American manufacturers will enjoy one important advantage over foreign competition. The United States today can produce more high-octane gasoline than any other nation. We have the crude oil, the refining capacity, and facilities for producing large quantities of Ethyl antiknock fluid. Commercial quantities of better-than-100-octane gasoline could readily be produced.

By developing engines to fully utilize this superior gasoline, American aviation people can give U.S. commercial planes superior performance and *economy* . . . important factors in the final determination of who shall eventually have the upper hand in peaceful competition.

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Airplane Descriptions

Flying the Spitfire XIV. "Indicator." An analysis of the flying and handling characteristics of the Spitfire XIV, with the differences in the power and equipment of the XIV from those of preceding Spitfire types noted. The article also identifies the various Spitfire models for which the successive Roman numerals stand. In evaluating the flying qualities of the XIV, attention is called particularly to the throttle control, the boost and climb, the lateral control, the airplane's reaction in a stall, and its aerobatic performance. *Flight*, August 16, 1945, pages 169–171, 3 illus.

The French Aircraft Industry. L. Graham Davies. Following a visit to the Marseilles and Toulouse factories of the Government-controlled Aerosudest, the writer offers some observations on this French company's current status in design and production; the obstacles with which French aircraft manufacturers were faced; reorganization and reconstruction efforts; and new methods and equipment that have been instituted since the liberation of France. He also reports the specifications and features of several French aircraft now under construction. These include the S.E. 200 flying boat, S.E. 1000 transport aircraft, S.O. 161 transport, and S.E. 2100 flying wing. *The Aeroplane*, August 10, 1945, pages 161–163, 10 illus.

A Statistical Comparison. Specifications for the Martin Mars and the Short Shetland are listed and compared. The table also includes an additional pay-load analysis of the commercial versions of the two flying boats. *Commercial Aviation*, August, 1945, page 55, 2 illus.

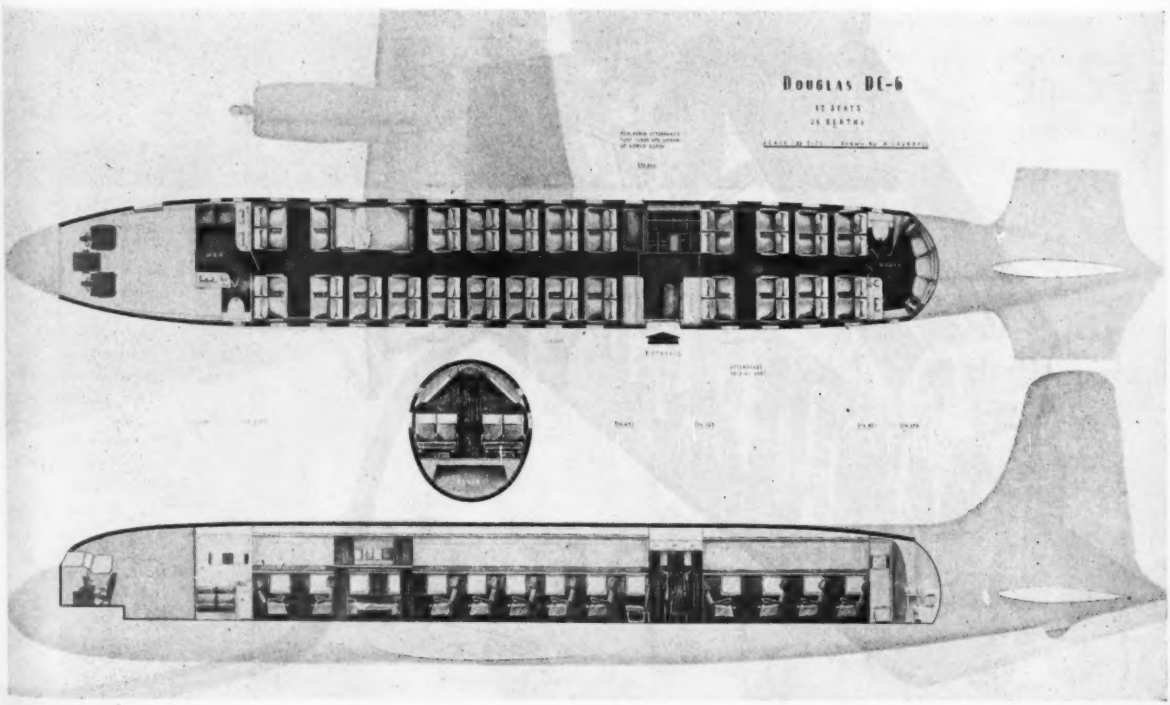
The Allocation of German Type Numbers. Part III. A third list of type numbers of German military aircraft gives brief descriptions of each type and the purpose for which it was designed. The current list includes the Arado, Blohm und Voss, D.F.S., Dornier, Fieseler, Flettner, Focke-Achgelis, Focke-Wulf, Gotha, Heinkel, Henschel, Junkers, Kalkart, and Messerschmitt. *The Aeroplane Spotter*, September 20, 1945, pages 222, 223, 10 illus.

A Preview of the Avro Tudor I. A comprehensive survey of the features of the Avro Tudor I, a pressurized British transport airplane built for high speed and long range. Accompanied by notes on the methods and equipment with which the components are manufactured, construction characteristics of the following are examined: fuselage, wings, empennage, undercarriage, power plant, and cabins. Particulars pertinent to the pressurization assembly, instruments, and accessories are investigated. The survey is supplemented by tables of data, performance, and weight figures, specifications, and illustrations. *The Aeroplane*, August 17, 1945, pages 185, 186, 189–191, 12 illus.

Four-Place Air-Car Is New Roadable Project. Brief notes tell about a proposed design for a roadable plane in which the aircraft's body (containing the power plant) could be detached from the air frame and fitted on a special automobile chassis to afford ground transportation, within a period of 5 min. Called the Airmaster Air-Car, the plane would be a four-place, low-wing monoplane pusher with twin tail booms, twin rudders, and tricycle landing gear. A 145-hp. engine would afford a top speed of 150 m.p.h. and the range of the aircraft is estimated at 500 m.p.h. Specifications and data for the design are listed. *Aviation*, September, 1945, page 174, 2 illus.

Civil Stirling. Following a brief announcement of the availability of the Short Stirling as an 18-passenger, mail, and freight aircraft, this article gives details of the conversion. It describes just what the modifications are and how the airplane is now fitted to accommodate passengers and cargo. Performance curves for the aircraft are shown. *Flight*, August 23, 1945, pages 205–207, 5 illus.; "Short Stirling—Civil Transport," *The Aeroplane*, August 17, 1945, pages 180, 181, 4 illus.

Back Into "Civvies." Design, construction, and performance details of the Avro Nineteen are surveyed. A civil version of the Avro Anson, the Nineteen is reported to be available for immediate use as a feeder-line aircraft. The article includes an outline history of the Anson up to the time of its reconversion to the Nineteen, an analysis of the cost figures for the Nineteen, and summaries of three typical loadings. *Flight*, August 9, 1945, pages 144, 145, 2 illus.



This floor plan and half section of the Douglas DC-6 shows the arrangement of the 56 seats. The plane, which is approximately 7 ft. longer than the DC-4, has a pressurized and air-conditioned cabin.

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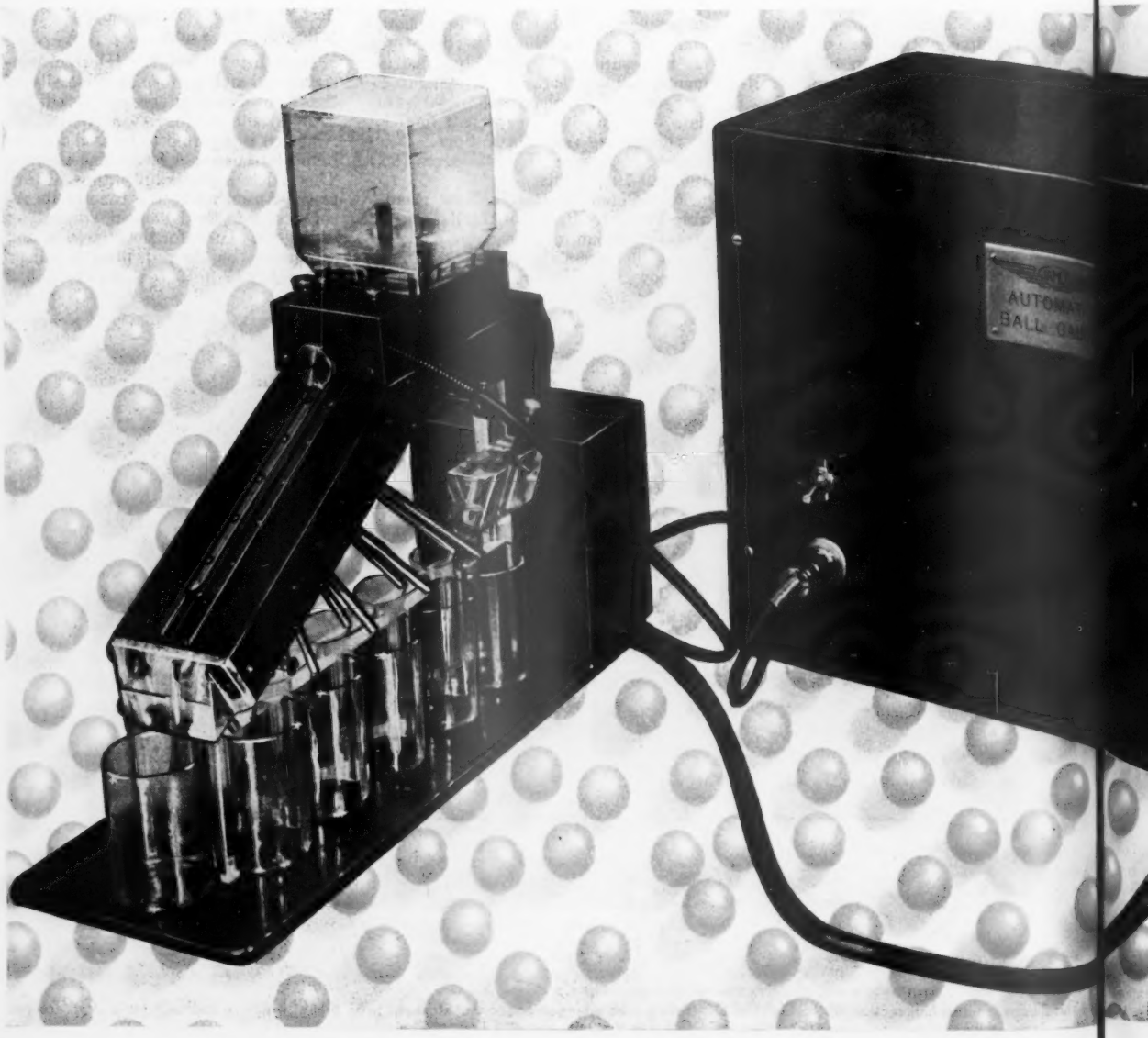

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The Swift, Globe Aircraft Corporation's new all-metal personal airplane, is of conventional semimonocoque metal construction. All components of the plane are designed for easy repair or replacement.

Aero Digest's Tabulation of Statistical Data on Warplanes Currently in Use by the Armed Forces of the United States. Statistical data are tabulated for 101 U.S. military and naval aircraft. The information listed includes the name of the plane and manufacturer, the Army or Navy designation, dimensions, weights, engines, performance figures, and supplementary remarks relative to the type of planes, distinguishing characteristics, production status, etc. *Aero Digest*, September 1, 1945, pages 62, 63.

Flying the Boulton Paul Defiant III. Flight Lt. D. A. S. McKay. A description of the Boulton Paul Defiant III consists mainly of details about the performance and handling characteristics of the plane. However, data regarding the aircraft's construction and design are included. Current uses of the Defiant are noted. *The Aeroplane*, August 31, 1945, pages 246, 247, 4 illus.

Airports and Airfields

Grass Roots. Leighton Collins. This report about private airports in northern New Jersey reveals that there is a need for improvement of existing airports so that they can accommodate all types of personal aircraft, and so that pilots unfamiliar with a specific airport can be reasonably sure of a safe landing. The writer claims that, of the 3,692 airports said to be operating in the United States, only a limited number have adequate facilities for accommodating "unfamiliar" landings of all types of personal airplanes. He advocates Government subsidy for improvement of these airports.

The report is based upon an airplane tour of Red Bank Airport, Lake Susquehanna Airport at Blairstown, Hackettstown Airport, Trinca Airport near Andover, Sussex Airport, Radio Frequency Laboratories field at Boonton, Lincoln Park Airport at Lincoln, Murchio Field near Paterson, Bendix Airport, Caldwell-Wright Field at Paterson, Morristown Airport, Somerset Hills Airport at Basking Ridge, and Hadley Field near Metuchen and Plainfield. Illustrations are included of all the visited airports and details noted about the quality and distinguishing characteristics of each field; types of planes which can land on each; special techniques for landing on the different airports; the ownership of each field; its facilities and its features. *Air Facts*, October, 1945, pages 72–96, 14 illus.

Raising Sagging Runways. Hugh A. Wallace. A description is given of a method of maintaining a level and rigid pavement, which has been used with success by the Ohio Highway Department. Hot asphalt is pumped through holes bored in the pavement to seal the joints and cracks from the bottom and stop the pumping of subgrade material to the surface. It is explained that surface water penetrates cracks and saturates the subgrade. Heavy traffic causes a pumping action that forces water and subgrade material up through the openings, causing a cavity to be formed under the pavement. It is stated that subsealing has been found the best method of ameliorating this condition. *Aviation Maintenance*, September, 1945, pages 42–46, 128, 16 illus.

Airport Engineering—A Specialist's Job. Those contemplating the building of an airport are advised of the economic value of retaining the services of a qualified engineering company that specializes in airport construction. Dangers inherent in relying on the "town engineer," in regarding the design of an airport as purely a civil engineering problem, or depending solely on information that can be obtained from the C.A.A., are demonstrated.

However, the article also outlines expense-saving preparatory steps that can be taken by the community before the engagement of an airport-engineering company. A guide to probable fees charged by airport-engineering companies is included. *Airports*, September, 1945, pages 31, 32.

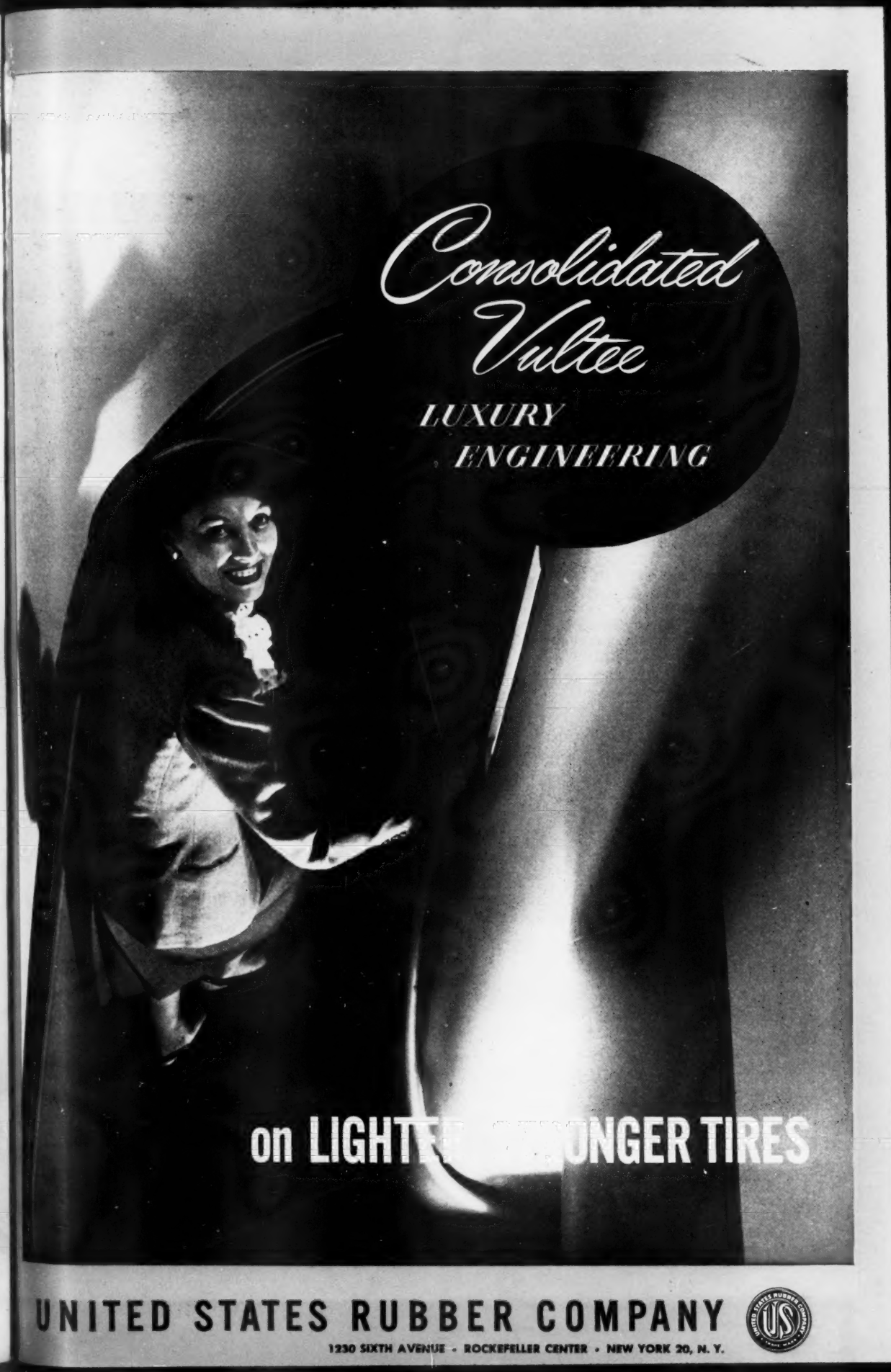
Expansion as a Governing Factor in Airport Planning. Harrison W. Rogers. A series of development plans is submitted for the building of an airport, with provision made for the efficient expansion of the airport from a small operation to one able to accommodate a great volume of air traffic and larger aircraft. The plans, shown in various stages of development, reveal how expansion can be carried out without disrupting operations entirely. The nucleus of the development is an original unit consisting of a small baggage and waiting room with a few offices and a roof for spectators, advancing to enlarged cargo-handling and personnel accommodations, while the upper floor is altered to contain new passenger facilities with second-floor loading. Then, when plane size increases, two new wings are added to the head of the old, reaching out far enough to accommodate the larger planes. The article traces the continuation of this development to its ultimate usefulness. *Aero Digest*, September 15, 1945, pages 58–61, 119, 4 illus.

Nine Thousand Miles of Concrete. This article deals with the organization and activities of the Air Ministry Directorate-General of Works, the bureau responsible for the design, execution, and maintenance of all R.A.F. buildings and civil engineering works throughout the British Empire. In describing the operations of the A.M.-D.G.W., the article is particularly concerned with the airfield construction work it accomplished during the war. *The Aeroplane*, August 31, 1945, pages 241–243, 6 illus.

Engineering the Small Airport Hangar. Col. B. C. Allin. Specifications are suggested for hangars built to fill the needs of small airports. The types of hangars recommended conform to seven specific requirements, namely: that they be (1) inexpensively constructed; (2) sturdy; (3) made of good materials; (4) fire resistant; (5) inexpensive to operate and maintain; (6) arranged in conformance with the layout of the field as a whole; and (7) so constructed as to be practically portable if necessary. *Western Flying*, September, 1945, pages 50, 52, 86, 3 illus.; "Hangars for the Private Flyer," by K. E. Van Scoy, *Airports*, September, 1945, pages 28, 29, 3 illus.

No Exclusive Airport Leases. In answer to a previous article advocating exclusive leases at public airports, the Chief of the Airports Service Section of the C.A.A. explains why the existence of such exclusive rights at airports financed by Federal funds would be restraint of competition. He also defines the protection which is accorded to the airport under the exclusive-right provision as it is now construed by the C.A.A. *Airports*, September, 1945, page 22.

Hydroports for the Private Flyer. Edward Doherty, Jr. The feasibility of floatplane facilities for private planes is demonstrated, with the claim ad-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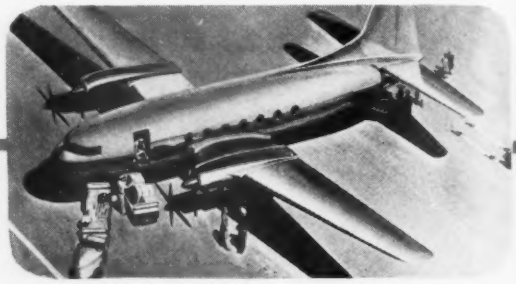

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Consolidated Vultee 37 When you enter this great queen of the skies, you will see the graceful circular stairway shown on the previous page. From London to New York in about nine hours, it will carry 204 passengers and 15,300 pounds of baggage with its six engines producing power equivalent to 353 average automobiles. As in all Consolidated Vultee planes large and small, passenger comfort and convenience come first.

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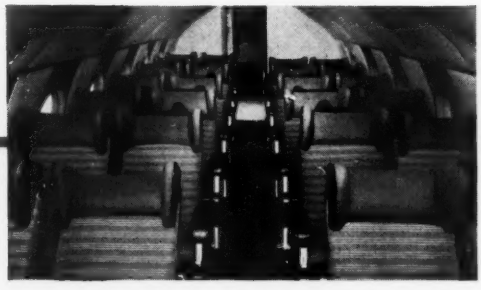

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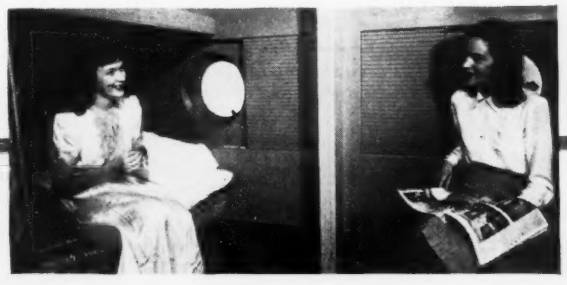

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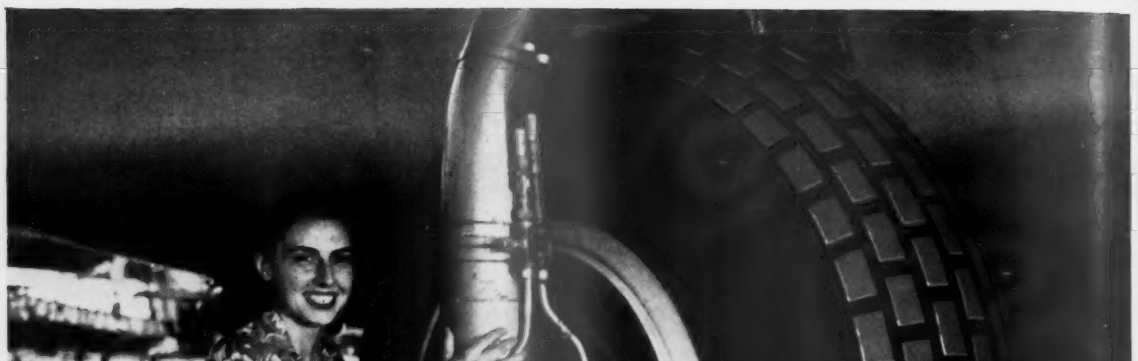

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vanced that the cost of building such facilities is comparatively low. Several specific designs for small-seaplane docks are suggested, based upon drawings and specifications originated by the C.A.A. in 1939. *Flying*, October, 1945, pages 46, 47, 108, 110, 4 illus.

Building the Small Airport. Part VII. Marc Thompson. This current installment of an article on small-airport construction deals with buildings. It is explained that it is difficult to make recommendations as to the size of the buildings because of the great changes and growth imminent in personal aviation. The article states principles of design whereby structures may be expanded. A plan for the buildings is shown. The requirements for airport buildings and the conditions affecting their design are discussed at length. *Aviation Maintenance*, September, 1945, pages 50–53, 105, 106, 108, 110, 112, 115, 116, 5 illus.

Safety in Airport Operations. Ray Brown. Stressing the necessity for care and accident-prevention routines in all phases of airport operations, the writer notes specific means by which various types of airport accidents can be avoided. His suggestions pertain to the establishment and enforcement of traffic and taxi patterns, flight-line and starting procedures, fire regulations, etc., as well as to the carrying out of comprehensive rules governing actual flying practices around the airport. *Western Flying*, September, 1945, pages 58, 60.

Some Pitfalls in Drainage Planning. August R. Butler. Certain dangers connected with careless or inadequate airport-drainage installations are explained, and advice is given on how to safeguard against or remedy the defects. Drainage mistakes about which the airport designer and builder are warned are failure to allow for settlement around inlet structures installed within the paved areas of the airport; faulty construction of outlets or spillways used at the edges of fill portions of the landing strips; failures along the line of the flume; inadequate protection of the sump around the inlet; use of the paved-gutter type of runway drainage; and the false economy of elimination of any type of drainage next to the paving on full boulevard sections. *Airports*, September, 1945, pages 18, 19, 68, 6 illus.

Our Foreign Air Base Muddle. Franklin D. Walker. A report is made on the complexity of the situation with regard to the United States' titles, rights, and interests in American-built foreign airfields. Problems involving U.S. operating rights are mentioned, while those connected with the disposal of airports not needed for postwar civilian or military use are discussed at some length. Major difficulties are attributed to the absence of documentary titles, lack of a clear-cut U.S. postwar security and economic policy, and incomplete records of the original costs of the airports.

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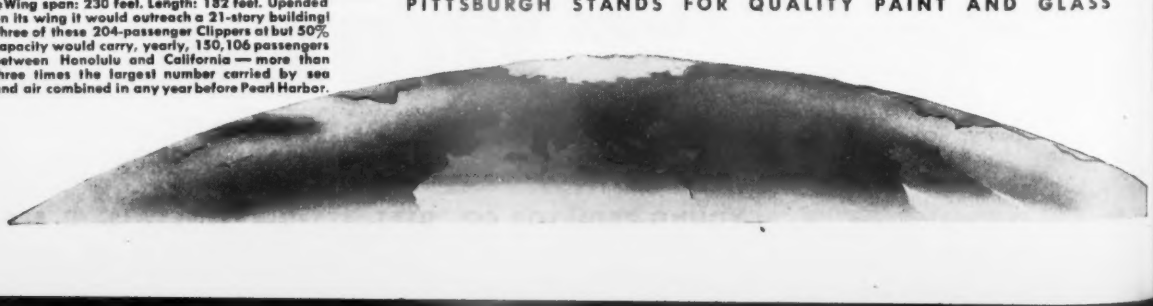

Middle East serve as a pertinent example. *Flying*, October, 1945, pages 26, 27, 114, 116, 118, 120, 3 illus.

Armament

Self-Contained Subassemblies Feature B-29 Four-Gun Turret. Part I. P. E. Humphrey. The initial installment of an article surveying the design and construction of the Superfortress's four-gun turret reviews the general features of this component, notes the specifications that governed its development, and describes the six subassemblies of which it is composed. A comparison between local control and remote-control systems of gunnery serves to indicate the advantages of the Superfortress's remotely controlled turret, while it is pointed out that division of the turret's construction into six self-contained assemblies makes for ease in manufacturing and servicing in the field.

The six assemblies are separated into: (1) elevation and azimuth drive units; (2) interrupter and collector assembly; (3) ammunition cases; (4) frame and chute assembly; (5) ring assembly and support castings; and (6) dome and enclosure.

Part I includes specific examination of the turret-ring assembly, turret saddle, drive units, frame and chute assembly, ammunition cases, and ammunition booster. Graphic illustrations are shown of the assemblies, with one schematic drawing outlining all the major parts of the turret. *Aviation*, September, 1945, pages 133–137, 10 illus.

Avigation

Finding the Navigational Stars. Part IX. Ben C. Kenny. In the ninth part of a continued article, an explanation is given of the mathematics underlying the working of a "fix," involving the solution of a spherical triangle or an astronomic triangle as it is called in navigation. Solutions are explained by means of spherical trigonometry and by ordinary trigonometry, but the speedier and simpler method using tables and computers is shown to be more practicable for the celestial navigator. These permit him to determine the computed altitude and azimuth and establish a line of position based on the observation of two navigating stars. When conditions such as fog or clouds prevent the observation of two stars, a running fix is obtained, for which instructions are outlined.

The writer then proceeds to show the location of six more of the navigating stars, these being Enif in the constellation Pegasus; Markab and Alpheratz in the formation known as the Great Square of Pegasus; Fomalhaut in the constellation Pices Austrinus; and Al Na'ir and Peacock in the constellation Grus. Directions are given for finding and identifying these stars. Two night photographs of the parts of the sky in which these stars are visible are reproduced, together with diagrams clarifying their position. *Aero Digest*, September 15, 1945, pages 56, 57, 112, 4 illus.

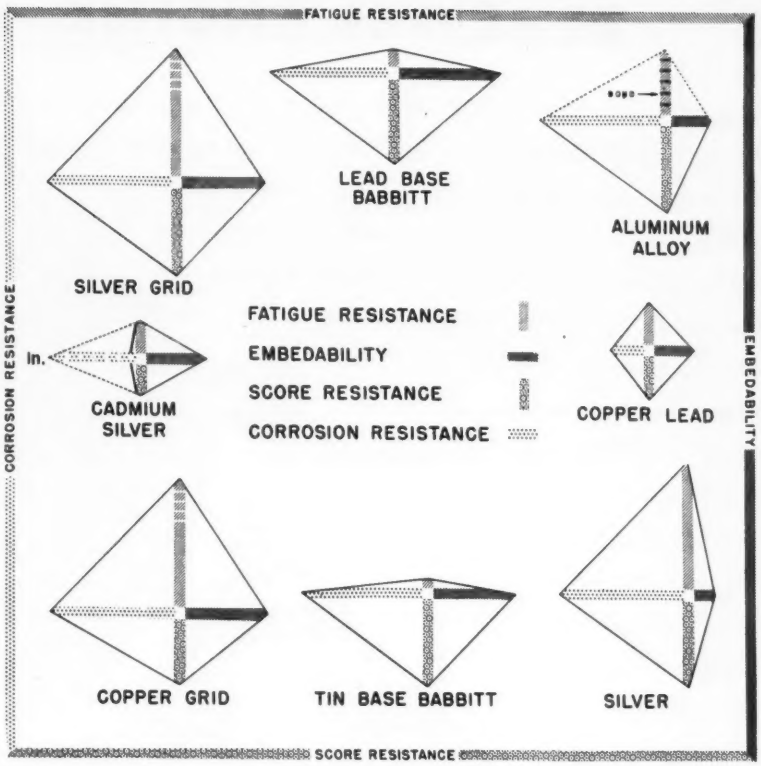

Photo Courtesy General Motors Corporation

Relationship of the four main functional properties of eight bearing materials.

Can You Read an Aero Map? M. L. Colbert. Defining the importance of aero-chart reading in avigation, this article contains instructions for map interpretation. It tells what to look for on an aeronautical chart, what the easiest methods of identification are, which are the most reliable landmarks, and which landmarks are subject to change. *Skyways*, October, 1945, pages 28, 29, 76, 5 illus.

Bearings

Silver Bearings. E. B. Etchells and A. F. Underwood. The part the Research Laboratories Division of General Motors Corporation has played in the development of silver bearings is outlined. The results of the Division's first studies on silver bearings are enumerated and the faults of early silver bearings are described. Information is given about the way improvements in the running characteristics were obtained. Other sections of the paper discuss performance characteristics, fatigue, score-resistance and embeddability, corrosion resistance, and the functional relationship of materials. The conclusions are summarized. *SAE Journal*, September, 1945, pages 497–503 (Transactions), 27 illus.

Civil Aviation

No Port Complete Without Gliders. M. Nanson Whitehead. The profit possibilities in gliders are pointed out to aircraft service operators. It is shown that good returns can be derived from investment in aircraft for towing privately owned gliders and in equipment for glider-training operations. It is further claimed that gliders are a means of attracting the public to the airport and that glider training contacts a group of potential customers who cannot afford to start their training by means of the more expensive power-plane instruction. The question of whether glider training and power-plane instruction can be conducted safely on the same field is answered with a decided affirmative. *Airports*, September, 1945, pages 44, 45, 4 illus.

Flying Stamps. An explanation of the plans of the Flying League of America also indicates the value of this plan for promoting flight training. The plan calls for the issuance of free flight instruction stamps as bonuses in merchandising or "employee relations" programs. *Flying*, October, 1945, pages 69, 128, 130, 2 illus.

Companies

Rolls-Royce Achievement. Based on a speech made by the Chairman of the company, facts and figures are recorded relative to the wartime expansion and development of Rolls-Royce,

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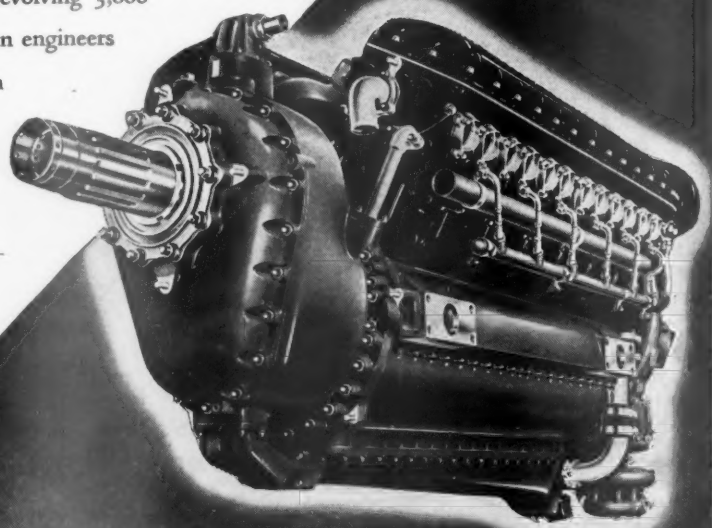
Like a fine watch, the Allison engine has a "21-jewel movement"—assuring dependability and long life. The jewels are the major silver-plated and copper-lead cast sleeve-type bearings, which absorb terrific loads and high temperatures from shafts revolving 3,000 times a minute. ★ Twenty years ago, Allison engineers pioneered the development of higher-precision sleeve-type bearings to enable engines to develop higher horsepower. Today, installed in virtually every aircraft engine made in this country—as well as Allison—these bearings have made good—at horsepowers far beyond the dreams of the Allison pioneers. ★ Now Allison bearings are available for other fine engines and machines to serve a world at peace.



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Limited. Increases in the number of employees, the extent of the facilities used, the number of engines produced, and the number of spare parts manufactured are noted, in addition to specific improvements in the firm's products and extension of the general scope of its activities. The developments reported are those particularly applicable to the production of Merlin and Griffon engines. *Aircraft Production*, September, 1945, pages 430–432, 4 illus.

Control Equipment

Theory of Automatic Control Systems. Donald P. Campbell. In the first of a series on the analysis and design of automatic control systems for aircraft, a brief history of the subject is supplied. Definitions are given by reference to elementary problems and to control systems for surface ships. The concepts of closed-loop control-system operation are presented and fundamental mathematical equations are set down in a form readily applicable to any general control system having properties similar to those outlined. An example is given in the form of an analysis of the operation of the system used to position the control surfaces of an airplane. *Industrial Aviation*, September, 1945, pages 62–64, 94, 95, 3 illus.

Toward Better Combination Controls. J. W. Kelly. Marking progress toward the achievement of aircraft controls combining the best features of mechanical, electrical, and hydraulic actuation, this is a review of successively developed combination controls produced by Adel Precision Products Corporation. Details are given about solenoid-operated selector valves and motor-actuated valves, with the advantages of each type for particular applications indicated. Other equipment described include an electrical-hydraulic unit for the actuation of light-airplane landing gears and flaps; an electrical-hydraulic unit designed for emergency auxiliary purposes and incorporating a motor, pump, reservoir, relief valve, and pressure and return ports; an electrical-hydraulic unit with a high-altitude pump and tank combination for its basis; and three different types of follow-up systems for power position controls, utilizing hydraulic power sources. One of these systems has a mechanical follow-up, the second a hydraulic follow-up, and the third an electrical follow-up. *Aviation*, September, 1945, pages 142–145, 12 illus.

Control System of the Lockheed Constellation. Clarence L. "Kelly" Johnson. A report is made of the problems solved in designing the hydraulic control system of the Lockheed Constellation. The advantages offered by the hydraulic control-surface booster are listed and a detailed description is given of the devices that are utilized in the control equipment. The work involved in designing the system, including the building of a full-sized mock-up, is reviewed. *Automotive and Aviation Industries*, September 1, 1945, pages 28–33, 96, 98, 102, 105, 16 illus.

Flexible Shaft Drives; Design and Installation Data. William J. Perfield. The results of a test program conducted by Lear, Inc., for the purpose of investigating the characteristics of flexible shafting are reported. Design data obtained from laboratory tests are supplied in graph form. It was found that flexible shafting with a case of rigid aluminum tubing gives higher efficiency than when used with the conventional wound casing. The design of a typical flexible shafting installation is described. *Product Engineering*, September, 1945, pages 594–597, 11 illus.

Deicing

De-Icer Pumps Demand Expert Care. Techniques are suggested for the servicing and testing of Romec pumps used for operating deicers and instruments. The recommended procedures and equipment pertain to the inspection and servicing, disassembly, inspection and repair, reassembly, testing, installation, and lubrication adjustment of these pumps. Numerous schematic drawings and tables of data supplement the directions. *Aviation*, September, 1945, pages 155–160, 12 illus.

Design

Design Analysis of the Martin PBM-5 "Mariner." E. G. Riley. Constructional features of the latest version of the Martin Mariner are analyzed. It is noted that this aircraft is designed to serve as a long-range patrol bomber and as a passenger and heavy transport plane. Information is supplied about the flight deck, wing, tail, main flight controls, ailerons, rudder, tabs, and flaps. Other sections describe the bomb controls, engine controls, and features of the power plant. Particulars are given about equipment. Illustrations and drawings reveal design details of this aircraft. *Industrial Aviation*, September, 1945, pages 7, 8, 10, 12–14, 16, 18–20, 97, 19 illus.

Designing a Boom-Tail Pusher. Part II. R. G. Naugle. The second section of a study of the design problems of the boom-tail airplane, especially for the private airplane market, examines the aerodynamic and structural aspects. With regard to the pusher type, comments are made about the shape of the cabin and its fairing in relation to the airflow and to the forces acting on the boom and tail structure. Among the factors considered in connection with the airflow are the shape of the windshield, the velocity and rotation of the slipstream, the wing down-wash, the drag elements, and the placing of fairing to combat the tendency to stall. The propeller location at a high point at the rear of the cabin also exerts influences on the take-off and landing characteristics that make it advisable to schedule wind-tunnel tests with a powered propeller early in the development of the design. Aerodynamic factors to be considered in the design of the booms include the boom angle; its fairing; the acceleration forces; and the arrangement for twin fins and rudders with the resultant increase in stabilizer-elevator effectiveness. The twin tails and long, straight elevator are stated to be advantageous. Brief remarks are made about engine cooling, accomplished directly by the air stream or by ducts or blowers, either of which involves certain aerodynamic provisions.

The structural considerations are examined at length with regard to boom stiffness and the loads for which the boom-tail structure must be stressed to withstand the flight and landing loads. The writer concludes that the boom-tail airplane must be analyzed as a whole from the dynamic point of view and the complete structure must be checked for vibration and incipient flutter. He compares the boom-tail pusher type with the conventional tractor fuselage for the private-plane market and suggests that the designer explore the possibilities of the tailless and semitailless types, as well as the so-called "two-control," canard, and semiflying-wing types. *Aero Digest*, September 1, 1945, pages 76–78, 182–184, 4 illus.

Tactical Drag. The writer remarks about the adverse effects, upon the aerodynamic performance of military aircraft, of the increased frontal area caused by the addition of combat equipment. Illustrations show front outline views of six fighter and bomber types as originally designed, and in the form necessitated by the attachment of external armament and accessories to meet tactical requirements. *Aeronautics*, September, 1945, pages 50, 51, 6 illus.

Structural Arrangement of the High-Wing Monoplane. Richard G. Naugle. The design features of the high-wing monoplane type for a small airplane for private flying or for short-range general-utility use are analyzed. The writer takes as an example his Mercury design. He considers the basic dynamic loads imposed on the fuselage, showing what percentage of the total gross weight is represented by the various components of the aircraft. Relationships between the flight structures and landing structures are traced with respect to the stresses to which the parts are subjected. An explanation is given of how these design features are incorporated in the construction of the airplane and the advantages derived, from the standpoint of manufacturing processes, weight saving, and ready convertibility for different purposes. *Western Flying*, September, 1945, pages 40–42, 66, 68. 7 illus.

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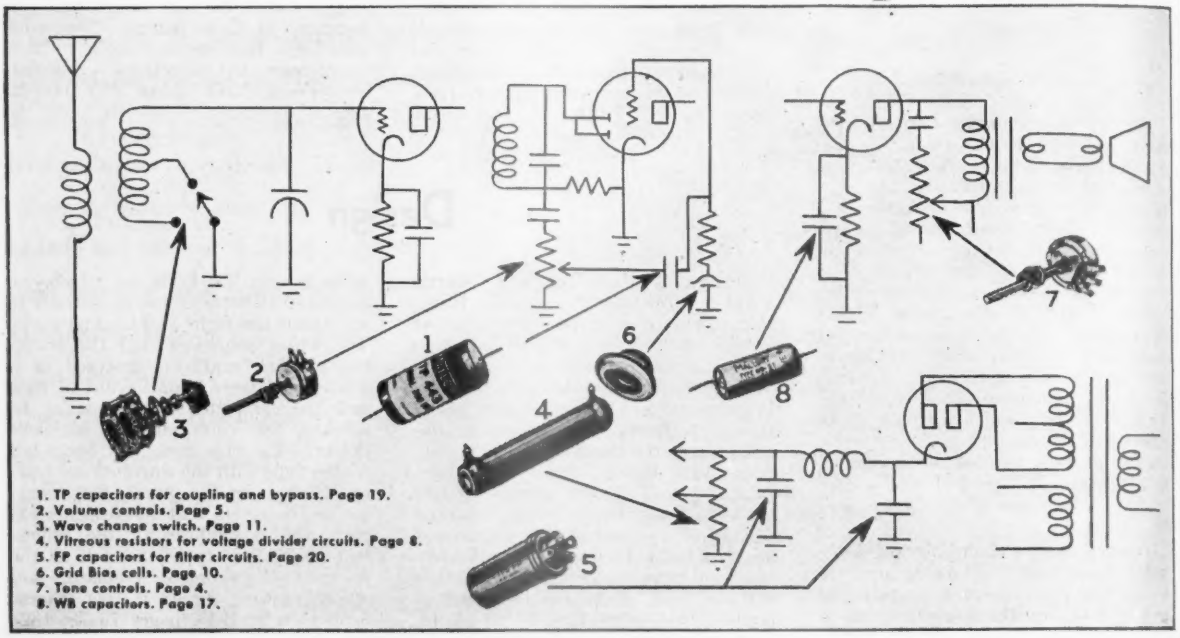

1. TP capacitors for coupling and bypass. Page 19.
2. Volume controls. Page 5.
3. Wave change switch. Page 11.
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Design Details of the Goodyear Model K Airship. Part III. Capt. C. V. S. Knox. The third part of a comprehensive engineering study of the Goodyear Model K airship continues with data about the power plant and accessories. It includes a discussion of the airship's lift principles and the methods by which pressure and trim are maintained. The check-list procedure that the airship pilot follows in preparing for flight is outlined.

Although the design details reviewed are those of the Model K as a naval airship intended for convoy escort and patrol duty, the concluding part of the article describes the special equipment with which the K is fitted when it is employed for air-sea rescue work. Certain particulars are also given about the Goodyear Model M airship. *Aero Digest*, September 1, 1945, pages 70–75, 180, 10 illus.

Your Small Plane of the Future. William B. Stout. Light-plane features that may reasonably be expected by the future purchaser are discussed. Pointing out that improvements in types and qualities of light planes are dependent upon factors of cost and sales volume, he investigates problems involved in developing the kind of roadable plane that he believes is wanted by the public at the price the public is willing to pay. Problems considered include those of cost, performance, safety, structure, appearance, and vision. *Air Trails*, October, 1945, pages 24, 25, 92–95, 2 illus.

Designing Tomorrow's Personal Plane. Part IV. Ralph H. Upson. In the fourth section of a serial article about the design of future aircraft for personal use, the writer surveys the favorable and unfavorable aspects of the pusher type as compared with the conventional tractor type. By definition, the pusher type is limited to the directly connected engine and propeller, disregarding those drives using extension shafts or other transmission devices. He reviews what he calls the obvious difficulties, as well as the "concealed" faults that have apparently been overlooked in other discussions. Among these, consideration is given at length to the position and travel of the center of gravity, concluding that for the size and class of airplanes involved, the c.g. travel of the pusher type will be at least 20 to 25 per cent of the mean aerodynamic chord, compared with a maximum of 5 to 10 per cent for a well-designed tractor. Other factors are safety, as exemplified principally in the matter of vision and propeller protection, and with reference to the prevention of accidents to the airplane, its occupants, and others, in the air and on the ground; aerodynamic considerations with regard to airflow, lift, and flap design; and cooling and landing-gear problems. A summary shows that by comparison with a low-wing conventional tractor design of equal capacity, speed, and range, the high-wing tricycle pusher will have substantially greater size, weight, and cost, larger fuel consumption, slower top speed, faster and longer landing runs, lower safety expectation in event of accident, and doubtful improvement in overall safety. In the favorable category, vision is expected to be somewhat improved, take-off distance about the same, and propeller protection generally better.

With regard to the tailless, canard, and other types of pusher aircraft, the aspects of aerodynamics, control, and vision are studied and the pusher found to have numerous disadvantages, except in certain special cases, such as roadable aircraft, seaplanes, or amphibians. However, it is noted that one of the most important considerations is the influence of the propeller slipstream in the conventional tractor design. It is stated that the turbulent nature of the airflow from the forward-mounted propeller may provide impelling reasons for the adoption of the pusher type, especially if certain improvements can be made, such as aerodynamic surface smoothness, better shaft drives for remote power transmission, lighter and smaller power plants, and assistance in take-off. *Aviation*, September, 1945, pages 128–132, 2 illus.

Control Surface Design in Theory and Practice. M. B. Morgan and H. H. B. M. Thomas. The design of aircraft ailerons, elevators, and rudders is analyzed in this extensive paper, which is divided into three sections. In Part I, dealing with practice, design problems common to all three controls are considered and the difficulties associated with each individual type of control are discussed. The problem of controlling the extremely large aircraft is also touched upon.

Part II, treating of theory and experimentation, outlines the present knowledge of control power and balance and describes the way in which theory is being developed to explain recent wind-tunnel results. In Part III concluding remarks are made on prototype testing, instrumentation, and training of the flight-test team. Numerous charts depict the results of comprehensive tests and calculations. Tables contain figures representing current practice in control-surface area and other factors, and the control forces exerted by the average pilot. Appendixes contain mathematical expositions of the theories applied, as well as a verbatim report of the discussions that followed the presentation of the paper at a meeting of The Royal Aeronautical Society on March 1, 1945. *The Journal of The Royal Aeronautical Society*, August, 1945, pages 431–510, 36 illus.

The irregularity of receipt of publications from abroad necessitates the review of articles in issues several months late. This is done to provide readers with information regarding foreign technical progress as soon as the issues are available in the United States.

"An Airplane in Every Garage." Daniel R. Zuck. Noting the development progress that has been made, the writer explains some of the technical problems involved in the evolution of a practicable and salable roadable airplane. The factors which he discusses as being mandatory for an inherently safe and functional plane are roadability, nonstalling, glide-velocity limitation, two-control, and glide-angle control. Examples of roadable planes reviewed include the Waterman tailless roadable airplane, the roadable autogiro, and the Stout Aircar. *Aero Digest*, September 15, 1945, pages 53–55, 124, 7 illus.

Design Analysis of the Fairchild C-82 Packet. Part II. Irving Stone. This is the concluding half of an engineering study of the Fairchild C-82 long-range transport aircraft. Illustrated by numerous schematic drawings and photographs, Part II is concerned with the flight-control system, landing gear, power plants, equipment, and anti-icing and heating provisions. In the descriptions of these components, particulars are included about the aileron droop mechanism, elevator control, rudder control, ventilating system, nose gear, landing-gear control, landing-gear door operation, and brake hydraulic system. Other details pertain to the fuel and oil systems, electrical and communication systems, furnishings, oxygen system, and fire-extinguisher system. *Aviation*, September, 1945, pages 115–127, 19 illus.

Aviation Trends. R. G. Worcester. Comments are made about present and future developments in aircraft design. Design trends in carrier-based and land-based airplanes are studied with particular reference to the influence of reaction propulsion on the design of the fuselage, landing gear, and wings. Speculation about future types includes the possibility of reducing the fuel consumption, the use of automatic control devices to replace the pilot in combat aircraft, and radar-guided bombs. *Aeronautics*, September, 1945, pages 52, 53.

Belligerent Tails. Accompanied by remarks about the general trends shown in the design of tail assemblies, a group of drawings depicts the fins and rudders of various planes. The planes are American, British, German, and Japanese single-engined fighters and fighter-bombers. *Flight*, August 16, 1945, page 179, 1 illus.

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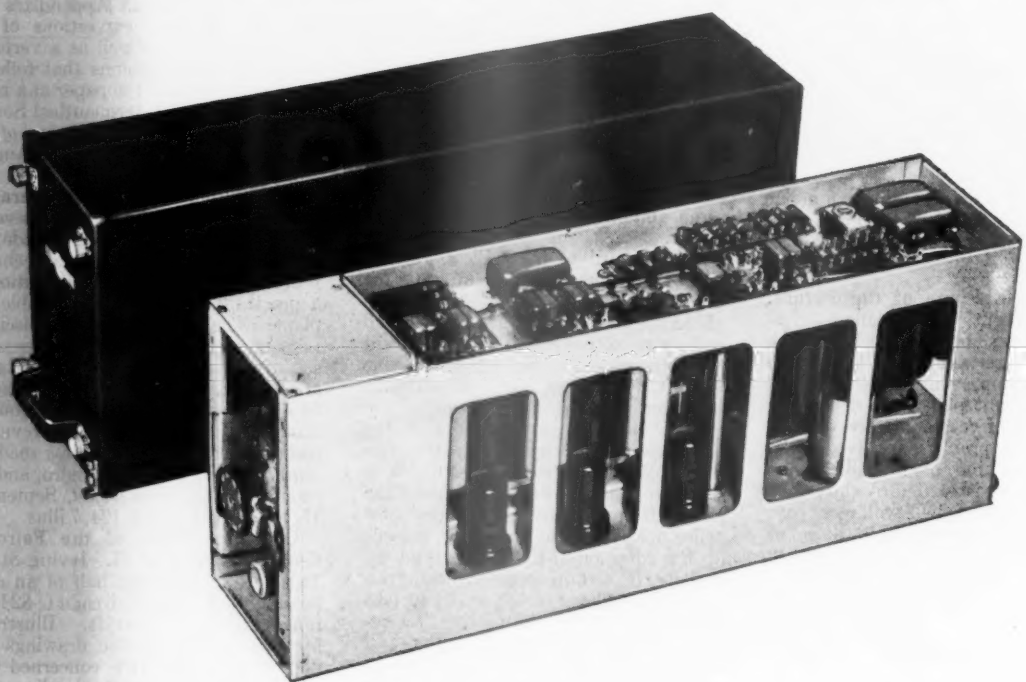

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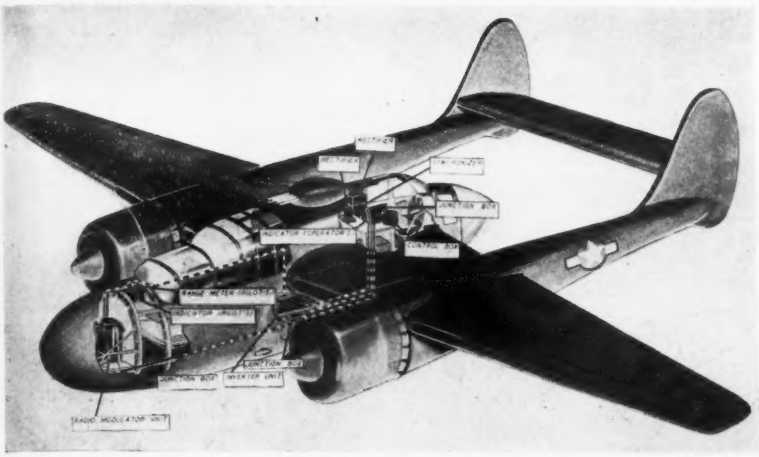

Photograph Courtesy Air Technical Service Command

Illustrated here is the general layout for the installation of only one of the many radar devices carried by the Northrop P-61 Black Widow night fighters to enable them to make raids despite darkness and overcast. Aircraft interception, developed through the facilities of the Radio and Radar Sub-Division of the Air Technical Service Command, permitted the radar operator to locate enemy aircraft and to direct the close-in for the "kill."

Electrical Equipment

An Interval and Dwell Tester for Bomb-Release Interval Controls. T. H. Long. Particulars are given about a device that is essentially a frequency meter with a scale proportional to the logarithm of 1/frequency and a dwell meter suitable for use on inductively loaded contacts in d.c. circuits. This article describes its use as an interval and dwell tester for bomb release interval controls. *Electrical Engineering*, September, 1945, pages 648–651, 4 illus.

D-C Aircraft Electrical Systems Design. R. W. Papenhausen. Reference is made to a previous article by the writer in which it was pointed out that common sources of trouble with the nonparallel operation of d.c. aircraft generators could be examined from the operational maintenance standpoint. The current article considers the application of sound engineering principles to system design, which will make for increased reliability and decreased inspection, maintenance, and repair work. *Industrial Aviation*, September, 1945, pages 34, 36, 88, 89, 2 illus.

Engines

The Mechanism of Spark Ignition. J. W. Linnett, E. J. Raynor, and W. E. Frost. It is noted that there is still much difference of opinion regarding the mechanism of gaseous ignition and the propagation of flame. Some of the theories that have been put forward and the experiments that have been conducted are briefly reviewed. An outline is given of experiments conducted by W. H. Thompson on the minimum ignition pressures of mixtures of hydrogen and oxygen in the presence of various added gases. The principal part of the paper is given over to a description of a repetition of Thompson's measurements with a less intense spark, and their extension up to pressures of the order of half an atmosphere. *Transactions of the Faraday Society*, August-September, 1945, pages 487–498, 3 illus.

Multi-Point Injection. Particulars are given about the design, operating principles, and merits of a multipoint fuel-injection system evolved by the S.U. Carburettor Company. As related, the basic feature of the system involves the use of a number of plungers of variable stroke, the number being equal to half the number of engine cylinders to be supplied. The pump is driven at crankshaft speed and the arrangement is, therefore, such that, where a four-cycle engine is to be supplied, one plunger can be employed to supply each of a pair of cylinders alternately. Differences between the S.U. multipoint injection pump and a German type are also indicated in the article. *Flight*, August 16, 1945, page 174.

The Armstrong Siddeley Cheetah 25. Complete specifications, performance curves, and general descriptive data are included in a review of the Armstrong Siddeley Cheetah 25 engine. The history of horsepower development from the original Cheetah to the 25 is outlined and the points on which the 25 differs from the Cheetah 15 are indicated. *The Aeroplane*, August 31, 1945, pages 252, 253, 4 illus.

Fuel Injection for the Aircraft Engine. Part II. F. J. Wiegand and D. W. Meador. Part II of a four-part article about the application of fuel injection to aircraft engines outlines the basic metering requirements that any fuel-metering device must satisfy. Consideration is given to the problem of automatic control, and to the measurement of airflow and fuel flow. Items that must be considered by the designer in laying out a fuel-injection system are illustrated in chart form. *Industrial Aviation*, September, 1945, pages 27–29, 88, 4 illus.

Piston Rings in the War. D. M. Smith. The writer analyzes the problem of designing a piston ring that will maintain an effective seal over a long period of time despite heat, pressure, corrosion, friction, and abrasion. The paper is based on the experience of the McQuay-Norris Manufacturing Company. Consideration is given to the selection of material and the problems of design. Various ring shapes and their functions are described at length, with comments on the results of tests. One appendix provides data on piston-ring surface treatment; another appendix gives formulas for calculating the tensile strength and elasticity of piston rings. *SAE Journal*, September, 1945, pages 521–530 (Transactions), 26 illus.

Ignition Systems. Gilbert C. Close. Advice is given on how to prevent, analyze, and remedy common difficulties in the ignition systems of aircraft engines. Routines for checking and maintaining the efficient operation of the various ignition components are recommended, as are procedures for repairing specific deficiencies. *Western Flying*, September, 1945, pages 43, 74, 76, 3 illus.

Elements of Power Plant Design. C. A. H. Pollitt. A résumé is presented of the work that has been carried out by British engineers in the development of liquid-cooled power plants for aircraft. Six fundamental elements of design upon which the general physical proportions and the mechanical, aerodynamic, and thermodynamic efficiencies are chiefly dependent, are enumerated. With regard to structural features, the writer points out that engine mountings have a structural importance out of all proportion to their implied function. Difficulties involved in the design of engine mounts are outlined. Other subjects examined include power-plant vibration, cooling and exhaust systems, cowling, and charge cooling. *Aeronautics*, September, 1945, pages 24–30, 13 illus.

German Aircraft Power Plants. Further information about German aircraft engines is supplied in an article taken from the British Air Ministry News Service. Particulars are given about the design of air-cooled and liquid-cooled types, turbojet propulsion units, turbojet and propeller combinations, and liquid rocket units. A table gives comparative data on the BMW 003 Jumo 004, and Heinkel-Hirth 001 jet propulsion units. *The Engineer*, September 14, 1945, pages 201–204, 3 illus.

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On May 20, 1927, a young unknown named Charles A. Lindbergh climbed into a tiny monoplane at New York and 33 hours and 30 minutes later landed at Paris, France. Immediately he became a world-wide hero.

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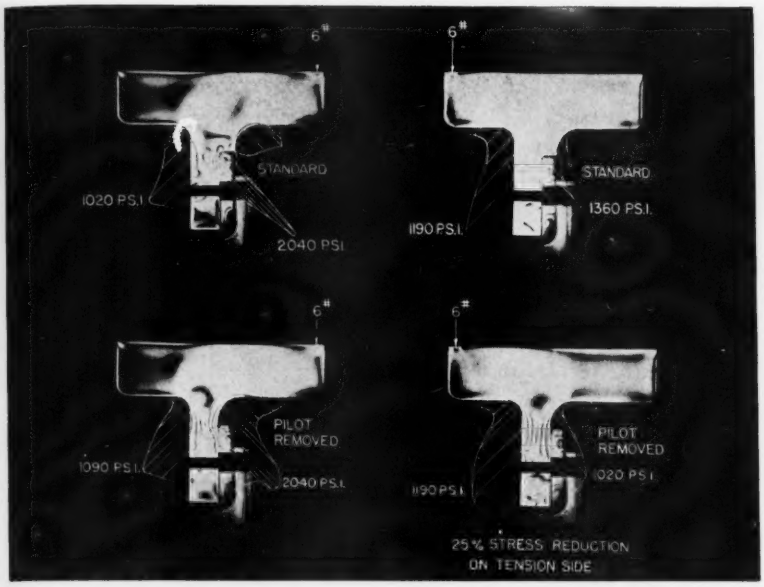

A photoelastic study of a reduction-gear mounting flange made by the Packard Motor Car Company.

Aircraft-Engine Gears. Forest R. McFarland. This paper describes some of the experiences the Packard Motor Car Company has had in producing gears for the Rolls-Royce Merlin engine. It outlines experiences in increasing the capacity of gears, particularly reduction gears, and methods used in designing gears of definitely greater capacity without any significant weight increase. The determination of the causes of surface distress on existing reduction gears at the start of production, and the elimination of the causes, are described. *SAE Journal*, September, 1945, pages 511–520, 560 (Transactions), 25 illus.

Pick Your Plane Engine. The history of the development of engines for light aircraft is traced from the time when motorcycle-engine parts formed the basis of many aircraft engines, to the current models. Showing the powerplant variations that now may be employed for several representative lightplane types, the characteristics of Continental, Lycoming, and Franklin engines are discussed and those of Ranger, Warner, and Ken-Royce models are mentioned.

The review also takes into consideration engines for helicopters and the possible effects of jet propulsion on future power-plant trends for light planes. *Skyways*, October, 1945, pages 32, 33, 86, 88, 90, 7 illus.

Extension Shaft Power Plant Offers New Design Possibilities. Alexander McSurely. A commentary reviews the developments directed toward the removal of engines from aerodynamic surfaces through the use of extension shafts from submerged engines to the propellers.

Particulars are given about the extension power shaft used in the Douglas XB-42 "Mixmaster" bomber and the DC-8 "Skybus," a commercial version with a similar power arrangement. *Aviation News*, October 8, 1945, pages 20, 22, 3 illus.

Flight Technique

Stall Speed Strait Jacket. Robert W. Ayer. It is stated that for years people have believed that it was safer for an airplane to be designed so that it could be landed slowly, but now airline operators have come to the conclusion that with higher landing speeds their operation will be safer in some respects and equally safe in others. The question of whether or not arbitrary limits on stall speeds should be removed is examined at length. Reasons are given to show that the proposed rules should contain no arbitrary stall-speed limits. *Air Transport*, September, 1945, pages 32–39, 7 illus.

The Stroke of the Eye. Wolfgang Langewiesche. An interpretation for the flight student of the proper technique of instrument reading. With explanations of why such a course should be followed, the advice is to "give the instrument one quick glance, then look elsewhere." *Flying*, October, 1945, pages 49, 106, 108, 1 illus.

History

12 Greatest Flights. Robert Craig. A chronology is given of the "twelve most important flights" in history, based on a "consensus" obtained by the author. In contrast to this group, the selections submitted by Edward V. Rickenbacker, Jerome C. Hunsaker, Harold C. Gatty, John P. V. Heinmuller, and Frederick H. Becker are listed. *Air News*, October, 1945, pages 17–19, 90, 91, 8 illus.

Hydraulic Equipment

Graphical Analysis of Performance of Hydraulic Shock Absorbers in Aircraft Landing Gears. Alexander J. Yorgiadis. The performance of simple hydraulic shock absorbers is obtained by the graphical method of analysis. Various elements and features of shock absorbers are presented and analyzed separately, including the variable-orifice type of control. Numerical examples are used to illustrate the effects of certain variables. *Journal of the Aeronautical Sciences*, October, 1945, pages 421–428, 9 illus.

Aircraft Hydraulic Units. Part I. J. A. Oates. First of a series of articles dealing with Dowty Equipment, Limited, and the various hydraulic aircraft units they manufacture. Part I outlines the history and development of the company. It also surveys the design of the undercarriage for the Lancaster bomber and describes the production and assembly processes by which the Dowty company manufactures this component. Among the procedures particularized are those pertinent to tube boring; the manufacture of the axle tube; a seven-headed Archdale machine that is used for drilling and reaming five right-hand and five left-hand undercarriage units; the production of the piston tube for the jack that retracts the undercarriage; plating; polishing; inspection; and the assembly of the panel unit. *Aircraft Production*, September, 1945, pages 414–423, 24 illus.

Inspection

Magnetic Inspection in Modern Industry. Earle D. Wilcox. The writer reviews the principles involved in the magnetic inspection method of discovering defects in the structure of the materials from which aircraft parts are made. A description is given of the methods employed in the application of this type of inspection at an aircraft plant. *Machinery*, September, 1945, pages 179–185, 9 illus.

Instrument Flying

Right and Left on Instruments. Wolfgang Langewiesche. First article in a series concerned with the fundamentals of instrument flying. Denoting the turn as the key problem in blind flying, the initial article analyzes the turn and tells how the pilot can sense it, keep it under control, and straighten out from it. It is the writer's opinion that the pilot tends to spiral, even with instruments, because he reacts more quickly and more decisively to air speed and climb-or-sink indications than he does to turn indications. Inadequacies in the conventional turn-indicator are pointed out and the pilot is advised how to cultivate quick and sure reaction to his turn-sensing instruments. The question of a mechanical "system" for

The "*lighter touch*" in landings

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controlling the turn with stick and rudder is discussed. *Air Facts*, October, 1945, pages 51–57.

Instruments

Advances in Aircraft Fuel Gaging. Edmond Kelly. The design and operating principles of the Avesco electronic fuel gage are described. Advantages of the electronic type of fuel gage over float-type gages, as well as the particular merits of the Avesco unit, are noted. In reviewing the evolution of aircraft fuel gages from the float type to the electronic type, the article also explains the operation of direct and remote-reading float-type gages, points out their limitations, and outlines some of the problems of fuel-consumption measurement which have to be solved.

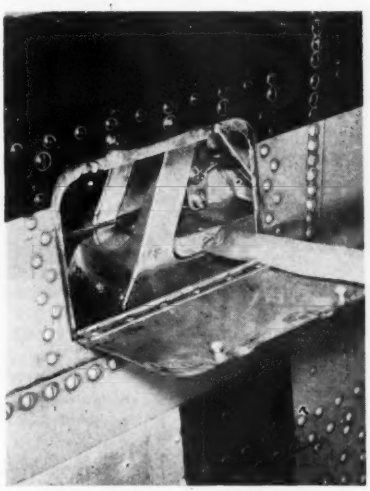
The fundamental principle of the Avesco gage is defined as the measurement of the dielectric factor difference between air and gasoline as the condition exists in the tank. Summarized, the advantages of the unit are reported to be the elimination of moving parts within the tank, an overall saving in weight, increased accuracy, the elimination of totalizing equipment used in intricate installations, measuring weight rather than volume, and simplification of maintenance. *Aero Digest*, September 15, 1945, pages 77, 120, 123, 2 illus.

Landing Gear

Putting Taxi Stability into Conventional Tail Gear. M. G. Scherberg. Particulars are given about a matched-cam type of load-centering tail wheel that was experimentally developed by Chance Vought Aircraft Division of United Aircraft Corporation for application to the Corsair airplane. The testing of the wheel and the results of the tests are reported. In the experiment, the objective was to design a set of cams that could transmit enough centering action to provide positive stability over a considerable part of the taxiing speed range and be sufficiently stiff directionally to allow safe cross-wind landings without locking the tail wheel, yet not be too stiff for turns from a standstill or at customary taxi speeds. Another specification was that, when the tail wheel was off the ground, the cams would be required to center the tail wheel by spring action.

As summarized in the article, the installation of such a wheel is credited with the following advantages: (1) The plane is directionally stable for normal taxiing conditions, hence taxiing is simplified and requires less attention from the pilot. (2) Pilot has one less control to remember for take-off and landing—lock control is removed. The cams provide a positive lock until condition of neutral stability is reached. (3) A positive antishimmy tail wheel is provided and shallow cams may prove practical for heavily loaded nose-wheel installations. (4) Longer and better service will be procured from brakes because they will not have to be applied so frequently. *Aviation*, September, 1945, pages 150–153, 8 illus.

Appreciation of Landing Problems. Part II. G. W. Drury. In the second and concluding installment of an article on aircraft landing problems consideration is given to castering stability and shimmy. The theory of shimmy in aircraft landing gears is explained. Means of preventing shimmy are considered. A description is given of different types of castering wheel assemblies. *Aircraft Engineering*, August, 1945, pages 218–223, 4 illus.



To simplify the procedure for adjusting aileron-control cables in DC-3 transport planes, employees of United Air Lines devised three jigs. One jig holds the control wheels in neutral position, another locks the central bellcrank and the third locks the inboard bellcrank in neutral. The inboard bellcrank lock shown above is placed in the bracket and adjustments on the outboard bellcrank are then made.

Maintenance

Inspection and Maintenance of the B-29 Gunfire Control System. A. B. Anderson and B. A. Wells. It is explained that the gunfire control system of the B-29 requires carefully coordinated field servicing. To meet the maintenance problem it was necessary for the Army Air Forces to train a large group of men, the majority of whom were relatively new in the electrical field. The article describes how haphazard methods in testing were avoided by devising a logical approach to the problem of locating trouble and isolating it to a small component unit or interconnecting wires. Particulars are given about a gunfire control tester designed to facilitate testing of the follow-up system. *Aviation Maintenance*, September, 1945, pages 55, 116, 118, 120, 122, 124, 126, 6 illus.

Give Your Engine Longer Life. Gilbert C. Close. With specific reference to light planes, the major factors to be observed in a program of engine preservation are discussed.

Methods and routines suggested pertain to four phases of such a program: (1) periodic major overhaul; (2) maintenance and inspection; (3) observance of operational limitations; and (4) preservation during inoperative periods. An engine-trouble symptom chart indicates possible causes for the following difficulties: failure to start; failure to develop full power; engine misfires (intermittently and at high speed); excessive vibration; preignition; detonation; sudden engine failure. *Flying*, October, 1945, pages 44, 45, 124, 126, 128, 3 illus.

Management

For Precision with Profit Key Those Costs. E. B. Sarreals. A survey of the methods, equipment, and controls with which the Kollsman Instrument Division of the Square D Company reduced its operating costs in preparation for competitive peacetime business.

Details are given about the material, operations, and inspection analyses that were made to determine the profit-consuming factors, and the measures that were devised to counteract those factors. *Aviation*, September, 1945, pages 138–141, 4 illus.

Accounting for Used Aircraft. Todd Mumma. A system of accounting suitable for recording transactions in the used-aircraft department is described. Illustrations are shown of the record cards used with this system. *Aviation Maintenance*, September, 1945, pages 47–49, 2 illus.

Marketing

Parts Producers Clarify Distributor-Dealer Discounts. John Foster, Jr. Based on a survey conducted among aircraft manufacturers, discount policies that may be expected in the distribution of aircraft parts and accessories are outlined. The report also indicates what the airplane producers will require from distributors in the way of personnel, type of operation, size of company, advertising and sales promotion, and financial reserves.

The two basic facts concluded from the survey are (1) Sales of aircraft parts and accessories will be made to the ultimate consumer through a fundamentally simple system extending from the manufacturer through the distributor, to the dealer, to the customer. (2) Distributors will have to plan their operations to work on discounts of approximately 50 per cent from list prices; dealers will operate on margins of about 25 per cent of list prices. *Aviation*, September, 1945, pages 178, 179, 1 illus.

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Materials

Magnesium Today. Thur Schmidt. Applications of magnesium alloys in industry are discussed, with particular attention to their uses in aircraft and automobiles. Information is given about the use of magnesium alloy for landing-gear struts, pilot seats, and hydraulic reservoirs. The writer advises against the tendency to promote the use of magnesium in uneconomic applications. He suggests concentration on uses of the metal to reduce reciprocating weight or increase the load-carrying potential, and on the great array of products requiring manual motions, where genuine benefits can be offered at competitive costs. *Modern Metals*, October, 1945, pages 4–6, 5 illus.

Forming 75S Aluminum Alloy. S. H. Phillips. Particulars are given about the forming characteristics of a new aluminum alloy designated by the Aluminum Company of America as 75S. It is stated that this alloy possesses tensile properties that are superior to any other aluminum alloy presently available to airplane fabricators. The alloy is commercially available in Alclad sheet and extruded forms. Data are given on the composition of 75S and on physical properties of 75S and 75S-T. *Industrial Aviation*, September, 1945, pages 30, 32, 33, 87, 3 illus.

New Uses for Cerium. G. Ahrens. The writer describes the properties and applications of cerium, one of the rare earth elements, for making stronger aluminum and magnesium parts and other engineering materials. Reference is made to the use of cerium-alloyed materials for certain aircraft-engine parts. *Metals and Alloys*, September, 1945, pages 748–750, 1 illus.

Medicine

Diseases and Defects in Aircrew Trainees. Lt. Col. John E. Leach. The results are reported of two surveys of diseases and defects observed in 344,134 men examined for air-crew training (as bombardiers, navigators, and pilots) at Army Air Forces Classification Centers and Army Air Forces Basic Training Centers. Details are included about how the examinations were conducted. One survey was concerned with diseases of the cardiovascular system; the other, with diseases of the pulmonary system.

In connection with the cardiovascular system, the rate of incidence and general findings are given for cases of congenital heart disease, defects of conduction, rheumatic infections, valvular heart disease, disease of the arteries and veins, and disturbances of blood pressure and circulation. One of the overall conclusions reached was that the primary physical examination for flying was an effective screen for most of the applicants for flight training. Another conclusion was that the majority of

the disqualifications for defects of conduction and disturbances of blood pressure and circulation were attributable to defects that were essentially of psychogenic origin.

In connection with diseases of the pulmonary system, findings are reported under categories of pulmonary tuberculosis and suspected tuberculosis; diseases and defects of the trachea and bronchi, the lung parenchyma, the ribs, and the pleura; and diseases of the mediastinum. The summarized conclusions were that: (1) The incidence of pulmonary defects and diseases observed in the group of candidates for air-crew training was considerably lower than that observed at induction stations. (2) The majority of the diseases for which the men were disqualified were initially suspected or detected by a history or a roentgenogram. (3) The routine roentgenogram or photoroentgenogram is valuable from both a medical and an economic standpoint. (4) In a number of instances, further questioning of examinees who presented active pulmonary tuberculosis revealed that, because of various uncontrollable factors roentgenograms had not been made of them at the primary examination. *War Medicine*, July, 1945, pages 1–8, 2 illus.

Principles and Problems of Maintenance of Fighter-Bomber Pilots. Major E. S. C. Ford. From experience with 155 combat pilots, recommendations are made regarding factors that are necessary and helpful in maintaining the physical and emotional well-being of military operational pilots.

Major problems encountered in such a program are described. The conclusions offered as a result of the study are that: (1) The more serious problem met with in the maintenance of operational fighter pilots is the frequent existence of emotional and intellectual immaturity within their personality make-up. (2) There is a need to indoctrinate flying personnel in America's plans and achievements in international postwar economic and political cooperation. This is alike an opportunity and an obligation to the soldiers, to prepare them for world citizenship in the future. (3) It has been demonstrated that the best combat records are made by the most mature and best integrated personalities —those classified as normal. (4) Among the personality disorders, the obsessive-compulsive personality seems best able to withstand the stress of aerial operations. (5) The performance records of men with anxiety neuroses and inaptitudes are so poor that their training is unwarranted. (6) Flying fatigue is not common among operational fighter pilots. A carefully systematized program of personality study is required to differentiate various psychologic defects and psychiatric states from this condition. *War Medicine*, July, 1945, pages 26–31.

Meteorology

ETA the Central Forecasting Station. The work, organization, operating methods, and equipment of Britain's principal weather forecasting station are reviewed. Situated at Dunstable, "ETA" (as it has been code-named throughout the war) is described as the headquarters of the British system for the supply of weather forecasts to the services and the general public. Its operations as the center of communications for weather information by teleprinter and radio are noted. *The Aeroplane*, August 17, 1945, pages 192, 193, 4 illus.

Military Aviation

Target Analysis. The tonnage of bombs dropped by the R.A.F. Bomber Command on various types of targets from September, 1939, to May, 1945, is shown in tabular form. Indicating the shifting importance of different kinds of targets, the tabulated figures represent monthly totals directed against industrial towns, troops and defenses, transportation, naval targets, oil targets, aircraft and accessories factories, specific industries, military installations, and miscellaneous targets. Numbers of mines laid monthly are listed. Two supplementary summaries demonstrate the yearly tonnage distribution by type of target in the Mediterranean theater of operations, and the total number of tons dropped on important German and German-held cities during the entire war. *Flight*, August 9, 1945, pages 154, 155.

With the R.A.F. in Norway. L. Graham Davies. Following a visit to units of the R.A.F. Transport Command in Norway, the writer relays some miscellaneous impressions of current military aviation conditions in Norway. He discusses the British-Norwegian dual command at the visited airports, explaining it as a temporary measure until the Norwegians are able to take complete control.

Among his comments are references to airport improvements made by the Germans, German aircraft that have been left in Norway and are now being used by the Allies, and the employment of German pilots for experimental flight testing. *The Aeroplane*, August 24, 1945, page 213.

Is the Bomber Obsolescent? Major F. A. de V. Robertson. Based on the premise that if rockets remain inaccurate, bombs will be the primary weapons of future wars, this article investigates Britain's prospects with regard to bombing vulnerability. It emphasizes that air attack is the greatest danger to an island power and claims that a strong defensive fighter force capable of warding off any such attack must be built up. *Flight*, August 9, 1945, pages 153, 154.

Paints and Coatings

Dope Economiser. A description is given of apparatus by the use of which small quantities of "dope" or other liquids can be siphoned as needed without necessitating the lifting or tilting of the dope container. The equipment is recommended by the writer for saving effort and preventing wastage. A diagrammatic view of the apparatus accompanies the description. *Aircraft Production*, September, 1945, page 432, 2 illus.

Plants

Design for Overhaul. Lee J. Bregenzer. Design suggestions are supplied for a repair and overhaul base for feeder-type air lines and aircraft service operators. In order to keep costs at a minimum and utilization at a maximum, a prefabricated one-story steel building is selected to house these shops. A plan shows the layout of the shop. Sectional drawings of the overhead crane and the test cell also are shown. The equipment of the shop is listed. *Aviation Maintenance*, September, 1945, pages 37–41, 128, 4 illus.

Plastics and Plywood

Wood Aircraft Assembly Glues. Arthur P. Dowling. Information is supplied about glues for use in operations that involve the gluing of wood members that are too cumbersome or too irregular in shape to place in a heated press. The writer discusses casein, urea resin, phenolic, and resorcinol assembly glues. Tables contain data on the typical strength values of assembly-glued wood joints, the characteristics of various assembly glues' the exaggerated effect of varying pH on the tensile strength of wood, and the shear strength of maple block. *Modern Plastics*, September, 1945, pages 156–158, 192, 194.

Fire Bombs Over Japan. The role played by cast and molded phenolic materials in the M-74 incendiary bomb is described. Phenolic materials are used for the phosphorous cups that break as the bombs strike land and pour forth the phosphorous which bursts into flames. Details are given about the manufacture of both cast and molded cups. *Modern Plastics*, September, 1945, pages 126–128, 7 illus.

Private Flying

Private Fliers' Operating Costs. John W. Friedlander. The President of Aeronca Aircraft Corporation offers an analysis of what it costs to operate a personal airplane for a year. Taking only definite cost factors into consideration, his figures lead to the conclusion that a comparatively small variation in horsepower, speed, and list price makes but little difference in the cost per mile traveled if the air-

plane is used to its full utility, namely, between 200 and 300 hours per year. Conversely, it is stated that if the airplane is not used much, the cost per mile of travel is, of course, unusually high. Tables show operational costs, based on the number of hours flown per year, for (1) a 65-hp. airplane selling at $1,500, and (2) for a 65-hp. airplane selling at $2,000; also, cost of operation per mile, as affected by the cruising speed and number of miles flown per year, for each of these two planes. *Airports*, September, 1945, pages 58, 59.

Private Pilot . . . Plus. W. W. Ward. The private pilot is advised to improve his knowledge of and experience with certain specialized flying techniques in order to derive more pleasure and utility from his piloting ability. Suggestions are given under headings of instruments, radio, larger aircraft, water rating, and night flying. *Air Facts*, October, 1945, pages 33–42, 3 illus.

Production

Gage Control. W. F. Johnson. A system of gage and tool control is described. The system provides for the control of new methods that have been introduced to obtain accuracy of production and is designed to ensure a continued flow of quality production. Illustrations are shown of the operation sheet for the control of inspection and production, gage-control and job-dispatch cards, and the precision-gage inspection record. Emphasis is placed on the desirability of having all gages and precision tools located centrally in the shop where accurate control for wear and correct records of distribution can be maintained. With this arrangement, many control features may be developed requiring a minimum of effort and time. *The Iron Age*, September 20, 1945, pages 68–71, 7 illus.

Drawing Specifications. H. J. Griggs. As outlined in a paper presented before the Institution of Production Engineers, a standardized method is explained for denoting on drawings the quality of surface finish required on machined components. The standards are those proposed by the British Standards Institution. In addition to describing the suggested system, the article indicates the need for agreed standards, compares the recommended method of specifying the required finishes with former means, and notes the advantages of the new system of symbolizing. *Aircraft Production*, September, 1945, pages 444, 445, 2 illus.

Pre-Planning of Shop Orders Cuts Material Waste. K. C. Cooper. An account is given of a critical-metals conservation program that brought scrap loss below 3 per cent at the Oklahoma City plant of the Douglas Aircraft Company, Inc. Conservation of critical metals was accomplished by operating the material-cutting department as a unit of the material division, whose primary functions include the efficient utilization of raw materials as well as their procurement. *Wings*, September, 1945, pages 1709–1712, 6 illus.

Fate of Fokker Factory. As related by one of the directors of the Netherlands company, this is a brief account of how the Fokker factory operated and what it produced during the German occupation of Holland. Passive sabotage by the Dutch factory personnel during this period is stressed. In addition, some of the company's present plans for resuming normal operations are outlined. *Flight*, August 30, 1945, page 227.

Corrosion of Aluminum by Die Materials. P. A. Haythorne. The writer gives a report on observations made at Lockheed Aircraft Corporation to discover the cause of corrosion of Alclad aluminum-alloy parts formed on Cerrobend drop-hammer dies. Means of preventing a spotty type of corrosion which occurred in Alclad 24S sheet-metal parts are outlined. It was found that the application of a heavy-bodied lubricant to both the dies and the Alclad sheet greatly aided in preventing the embedding of corrosive particles. *The Iron Age*, September 20, 1945, pages 72, 73, 4 illus.

Designing for Turning Operations. Paul Dutter. Emphasis is placed on the importance of designing a part in the simplest form that will allow it to perform its function, the desirability of using stock material and existing shop equipment wherever possible, and the advantage of keeping tolerances as generous as practical. *Industrial Aviation*, September, 1945, pages 58, 60, 93, 10 illus.

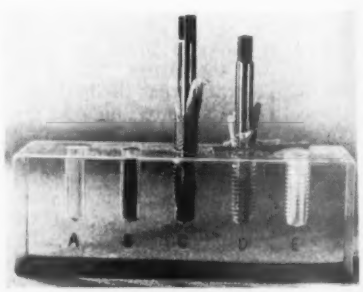
Machining Practice for Magnesium Castings. H. E. Linsley. Reference is made to the importance of the part played by magnesium in the manufacture of aircraft engines. It is stated that without the use of magnesium a specific engine-weight of approximately 1 lb. per hp. could not have been achieved. It is also stated that the use of magnesium by the Wright Aeronautical Corporation has increased to the point where more than 200 different items are manufactured from this material on a quantity-production basis. Each of the various milling operations that may be performed on magnesium castings is described. *Aluminum and Magnesium*, September, 1945, pages 12–14, 21, 5 illus.

Skin Heating. The writer describes how the surface finish of aircraft can be improved by thermal expansion of the light-alloy skin prior to riveting, through a process that makes use of electrically heated blankets to expand the light-alloy plating. After edge riveting, the blanket is removed and the skin becomes taut on the structure and riveting is then completed in the normal manner. It is stated that the resulting component is free from quilting and the oil-can effects that often result from standard riveting practice on thin sheets. The process is used by Vickers-Armstrongs, Ltd., in England, and the blankets are made by Warmex, Ltd., Cambridge. *The Iron Age*, September 6, 1945, pages 86, 87, 3 illus.

Ford Production Control Worked on Aircraft Too. Chester S. Ricker. How the system of production control used by the Ford Motor Company for 25 years was modified and successfully applied to aircraft production. The system embodies the use of "Engineering Inspection Numbers" for the control of newly introduced designs, new parts, changes, and repairs. E.I. Numbers guided purchasing, manufacturing, inspection, salvage, and cancellation activities inside and outside the Willow Run plant. *Wings*, September, 1945, pages 1713–1715, 6 illus.

Machining Bronze Counterweights for B-29 Crankshafts. A description is given of production operations connected with the machining of the counterweights for the crankshaft of the B-29 engine at the plant of the Ohio Crankshaft Company. The crankshaft assembly is composed of some 50 pieces ranging from major parts to small fastenings. A shift to bronze forged counterweights made it necessary to set up an entirely new self-contained machine line for these components. Details are given about the dimensional tolerances for the crankshafts and the procedures for machining, finishing, and inspecting the counterweights. *Automotive and Aviation Industries*, September 1, 1945, pages 22–24, 94, 7 illus.

Victory and Beyond. A survey of how the large-scale termination of



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military contracts affects the aircraft industry in terms of reduced dollar volume, number of employees, and amount of needed facilities. The improved status of the industry, even after cutbacks, is indicated as compared with its position before the war. In addition to the general survey, individual reports are given of how the following companies were affected by the terminations: Northrop Aircraft, Inc.; Republic Aviation Corporation; Ryan Aeronautical Company; United Aircraft Corporation; Bell Aircraft Corporation; Boeing Aircraft Company; Consolidated Vultee Aircraft Corporation; Curtiss-Wright Corporation; Grumman Aircraft Engineering Corporation; Douglas Aircraft Company, Inc.; Fairchild Engine and Airplane Corporation; Lockheed Aircraft Corporation; The Glenn L. Martin Company; and North American Aviation, Inc. Two tables summarize the extent of the cutbacks on principal airplane types and the employment reductions scheduled by leading California aircraft producers as a result of the cutbacks. *Western Flying*, September, 1945, pages 38, 39, 92.

Turbosupercharger Production Details. S. H. Brams. An account is given of welding, precision casting, and design innovations that have been devised to facilitate the quantity production of turbosuperchargers, as applied at the River Rouge plant of the Ford Motor Company. Various production operations are illustrated. *The Iron Age*, September 6, 1945, pages 88–93, 11 illus.

Costs Dropped, Quality Bettered, Through Statistical Controls. Eugene L. Grant. Reference is made to the many successful applications of statistical methods of quality control in the aircraft industry. Two representative applications of the Shewhart "$\bar{X}$ and R Chart" technique are described. One relates to a critical dimension of a component of a landing-gear assembly used in a Lockheed Lightning plane and the other to the control of spot welding at the Vultee Field Division of Consolidated Vultee Aircraft Corporation. *Wings*, September, 1945, pages 1716–1719, 4 illus.

Surface Broaching Simplifies Machining of Valve Rocker Arms. Harry H. Gotberg. A description is given of how one manufacturer is employing surface broaching to simplify machining operations on valve rocker arms for aircraft engines. All but two operations are performed on dual-ram surface broaching machines. *Machinery*, September, 1945, pages 176–178, 6 illus.

Propellers

Reverse-Pitch Propellers as Airplane Landing Brakes. Harold B. Crockett and E. Arthur Bonney. Reverse-pitch propellers operating with full engine power may be as effective in decelerating an airplane during the landing ground run as are conventional wheel brakes. The factors governing the effectiveness of reverse-pitch braking are power loading, wing loading, and such propeller characteristics as number of blades, diameter, and activity factor in comparison with conventional wheel braking. The result of varying the first two of the above factors is studied for the case of an airplane with a tricycle landing gear and the method of calculation is developed.

The great safety advantage of reverse-pitch braking for large airplanes landing on ice-covered, snow-covered, or wet runways is emphasized; the possibility of reducing the landing airport length required by the C.A.A. is discussed; and the reduction in tire and brake maintenance and replacement costs due to everyday use of reverse-pitch braking is considered. Also considered is the feasibility of reducing the glide plus transition distance by applying reverse-pitch braking during the final stage of the transition to eliminate floating. *Journal of the Aeronautical Sciences*, October, 1945, pages 441–447, 484, 9 illus.

The French Gnome-Rhone Mechanically Operated Propeller. John D. Waugh. Design features of a Gnome-Rhone mechanically operated three-blade propeller, bearing a date of manufacture June, 1939, are analyzed. This propeller was installed on a Gnome-Rhone 14M engine. Information is given about the design of the gear train, pneumatic actuator, bearings, one-piece hub forging, blades, and other component parts. *Automotive and Aviation Industries*, September 1, 1945, pages 34–37, 78, 80, 9 illus.

A Mobile Workshop. Trailer equipment comprising a mobile unit for servicing propellers is reviewed, together with details of the trailer's design. Developed by Rotol, Ltd., the service trailer features a swinging crane and a portable device that enables balancing to be done in the field. Its other tools include a universal blade-angle-setting protractor, a workbench with fly-press and vise, a metal workbench, battery and lighting equipment, a universal mandrel bracket, a gaging table, hub pressure-testing equipment, a blade clamp for root assembly, and a blade bearing assembly fixture. The trailer has a bed of 12 ft. 7 in. mounted on four 34-in. diameter wheels, and is fitted with the customary drawbar for towing purposes. *Aircraft Production*, September, 1945, page 413, 1 illus.

Lightplane Propeller Development. Part II. John D. Waugh. Part II concludes this study of the development of automatic and controllable-pitch propellers for light planes. Attention is given to the design and performance of the Gnome-Rhone automatic propeller; the Schwarz two-position propeller; the Milner automatic-multiposition propeller; the Wickwire-Spencer automatic propeller; and the Argus, Beechcraft, Freedman-Burnham, and Iso-Rev controllable propellers. The results of the study are summarized. *Industrial Aviation*, September, 1945, pages 39, 40, 42, 44, 45, 89–92, 13 illus.

Airscrew Torque-Coefficient. V. D. Naylor. It is stated that there are reasons for believing that in certain states of working the resultant aerodynamic force on a blade element of a propeller is normal to a helicoidal surface. An investigation is made to determine to what extent this is borne out by experimental results. It is found that between no-thrust and maximum efficiency, the hypothesis is confirmed by experimental results for a certain set of helicoidal propellers. In the course of the inquiry, a method of evaluating the torque coefficient over the same range is indicated. *Aircraft Engineering*, August, 1945, pages 229–231, 3 illus.

Radio

Radio Aids to Navigation. S. S. Stevens. The second article in a series of six dealing with the technical aspects of radio and communication in Canadian air transport. In Part II the field of radio aids to navigation is discussed under the categories (1) short-range aids to navigation, used mostly in conjunction with land routes; and (2) long-range aids to navigation, generally used on routes over water or sparsely settled country. Essential radio-range requirements for air-line operation are outlined and engineering factors to be considered in the selection of equipment to fly a two-course V.H.F. range are indicated. Engineering factors noted include frequency coverage; polarization; modulation; channel separation; weight; power supply; control; and sensitivity. Suggested specifications for long-distance radio navigational aids are examined under the following headings: services required; distance coverage; accuracy; navigating on position line; and band width. The article also contains pertinent information concerning ground-station direction-finding systems. *Commercial Aviation*, August, 1945, pages 68, 70.

C.E.R.C.A. A report of the conclusions reached and recommendations made at the London meeting of the Commonwealth and Empire Conference on Radio for Civil Aviation. The Conference's opinions are related with regard to general operational requirements for radio aids to civil aviation, including radar; the services required from these radio aid systems; and the equipment available for their immediate introduction. Views and recommendations on the development of radar aids are among those stressed. The Conference's work with the regulatory side of radio for civil aviation is noted. *Flight*, August 30, 1945, page 235.

Radar—Do Airlines Need It? Allen Scott. The possible future use of

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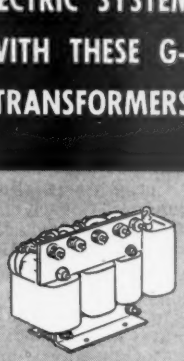

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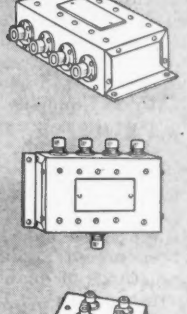

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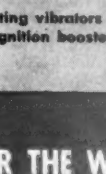

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radar equipment in the field of commercial air transport is examined. Consideration is given to adaptations and improvements in radar equipment for air-line use. It is stated that radar beacons may eventually displace present low-frequency radio ranges and also may make proposed and promised V.H.F. radio ranges obsolete.

Ultimately, it is indicated, the combination of radar and the radio altimeter in an airplane and radar beacons on the ground could provide a means for full instrument landings. *Air Transport*, September, 1945, pages 26–31, 8 illus.

Reaction Propulsion

Principles of Rocket and Jet Propulsion and Propulsive Materials. Z. Krzywoblocki. A simplified mathematical explanation is given of the principles of rocket and jet propulsion in this first section of a serial article. Consideration is given to possible applications of these methods of propulsion in aviation, including long-distance bombing and the delivery of mail. Propulsive materials and possible future developments in reaction propulsion are discussed. It is stated that the superiority of jet propulsion over rocket propulsion is quite obvious, since in the former the maximum value of external efficiency is reached at a much lower flight velocity than in the case of rocket propulsion. The necessary mathematical expressions are derived and explained. *Polish Engineering*, July, 1945, pages 51–56.

How Jet Propulsion Simplifies Cruise Control. James B. Rea. After a brief explanation of the basic principles of reaction propulsion, and of the formulas for measuring power generated by jet engines and gas turbines, a comparison is made of the efficiency calculations for such power plants with those for the conventional reciprocating engine. Methods of flight testing to obtain cruise-control data are compared, noting that a simpler procedure is possible with the reaction unit. It is suggested that thrustmeters for flight testing of jet-propelled aircraft will permit further simplification of the work of testing such craft and establishing cruise-control standards, by enabling engineers to calculate airplane-drag characteristics and engine-thrust characteristics accurately. *Aviation*, September, 1945, pages 184, 185.

German Turbo-Jet Powerplant Revealed as Compact, Efficient. A commentary on the BMW 003 turbo-jet unit which, at the time Germany fell, had been scheduled for full production in the fall of 1945. This power plant is credited with having excellent possibilities for further development. Its performance is said to approach the 2-to-1 thrust-weight ratio goal. *Aviation News*, September 10, 1945, page 36.

Reconversion

Navy Recovers Aluminum for Aircraft. Donald L. Colwell. The Coordinator of Conservation, Materials Division, Navy Department, discusses policies and techniques for the disposal of the billion or more pounds of aluminum from obsolete or war-worn military aircraft. Consideration is given to the average amount of aluminum in an airplane, scrap composition, and recovery processes. Advantages of the liquid briquette method of recovery are explained. *Modern Metals*, October, 1945, pages 8–12, 4 illus.

Research

The R.C.A.F. Research and Development Division. Announcement of the creation of a new branch of the Royal Canadian Air Force, the Research and Development Division, is supplemented with a brief biography of Air Vice Marshal E. W. Stedman, who will head the Division, as well as by an outline of the Division's functions. As reported, the duties of the Research and Development unit will consist of (1) the initiation and coordination of all research development and experimental work for the R.C.A.F.; (2) the technical supervision of all research and development establishments; (3) the distribution of scientific information to personnel of the service; (4) cooperation with the aircraft industry in the development of aircraft suitable for R.C.A.F. purposes; (5) as a liaison on research and development subjects between the R.C.A.F., the other services, and all outside bodies. *Commercial Aviation*, August, 1945, page 75.

Use of Automatic Calculation Methods in Aeronautical Research. Max M. Munk. An explanation of how automatic calculation by means of punched-card machines can be applied to aeronautical problems involving technical and mathematical work. The machine and the automatic computation steps connected with its operation are described. A typical problem of aircraft engineering recommended as suitable for computation by the punched-card method is the determination of the span lift distribution. Another is stress computations for a system having a large number of redundancies. *Aero Digest*, September 1, 1945, pages 68, 69, 192, 1 illus.

Rotating Wing Aircraft

A Direct Method of Estimating Performance of a Helicopter in Powered Flight. Walter Castles, Jr. This paper presents a direct method of calculating the performance characteristics of a helicopter in powered flight. The method is based on the simple momentum theory but incorporates the primary effects of the vertical drag force and an empirical correction to the induced power. Nomograms are included for the rapid solution of the useful equations. *Journal of the Aeronautical Sciences*, October, 1945, pages 477–484, 14 illus.

Reappraisal of the Momentum Theory. Haviland H. Platt. The writer suggests a re-examination of the fundamental basis of the theory of hovering, because it has been found that discrepancies of as much as 25 per cent in some cases have appeared between the theoretic and actual power requirements for pure free hovering performance of a helicopter. He reviews the assumptions taken in the momentum theory and shows how they are contradictory in certain respects. Reference is made to observations of the airflow about a hovering rotor which show a strong recirculation of air in a large "doughnut" vortex, an effect that may account for all or a part of the observed power loss. Other factors that have an influence are mentioned. It is indicated that, although all of the theoretic conditions assumed may not be present in ordinary practice, the subject offers a fertile field for further research. Comments by Alexander Klemin are appended with regard to the reasons for the discrepancies noted by the writer. *Aero Digest*, September 1, 1945, page 80, 1 illus.

Basic Factors of Helicopter Design. R. H. Prewitt. The basic factors of helicopter design are set forth in simplified form. In addition, the writer demonstrates a method of designing a helicopter so that it will have optimum efficiency for both hovering and cruising flight. A further extension of helicopter design involves the use of a chart on which an efficiency factor versus operating blade lift angle is plotted. All deviations from the theoretic expressions are compensated for on this chart, which provides an overall comparison and design aid. *SAE Journal*, September, 1945, pages 531–533 (Transactions), 4 illus.

Principles of Rotary Wing Aircraft. Part VI. Alexander Klemin. The sixth section of a serial article continues an examination of the theorems and experiments in vertical descent, taking up the effects of variation in loading per square foot; variation in the solidity ratio; and the effect of profile drag coefficient on the rate of vertical descent. Reference is made to equations developed in the preceding section (Part V) through which it is shown that a high profile drag is synonomous with a high rate of vertical descent and that, as in hovering or in vertical ascent, induced velocity loss will be a minimum if flow through the disc and the loading are uniform. Uniform flow through the disc can be obtained by varying the chord only. Answers are given for two related questions: (1) What is the best airfoil for vertical descent? and (2) At what angle of attack should it be working for minimum rate of vertical descent? The procedure for designing the ideal rotor for

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vertical descent is then stated, although it is noted that such a design may be unsuitable for other conditions of operation, it being offered as an ideal standard of comparison with the design of rotor actually selected.

The causes of stalling are investigated, as well as the distribution of autorotative properties along the span of the blade. Tentative design conclusions are summarized and observations are stated with regard to the results of the work outlined. Three problems are given for solution by the reader. *Aero Digest*, September 1, 1945, pages 83, 84, 87, 169, 170, 1 illus.

Potential Use of the Mercury Clutch in the Helicopter Powerplant. A description is given of a centrifugal clutch used to connect the engine to the rotor of a helicopter. It is stated that the clutch, made by the Mercury Clutch Corporation, has given satisfactory service in a large number of Army, Navy, and industrial applications, and is now being installed for helicopter service. After outlining the 15 characteristics suggested as essential in a clutch suitable for helicopter use, the writer explains the principles upon which the mercury clutch operates, as well as the construction and operation of that particular unit.

The clutch consists of a drumlike member attached to the power source and containing a small quantity of mercury confined in a narrow annular space. When the drum is revolved the centrifugal force drives the mercury outward, while the pressure thus created acts directly on the friction members, bringing them into contact. Figures given for the performance of the clutch when used with a 275-hp. Lycoming R-680-E3A engine are also plotted on graphs showing torque compared with speed, and engine speed compared with acceleration time. *Aero Digest*, September 1, 1945, pages 92, 93, 176, 4 illus.

Stress Analysis

The Simplification of Flutter Calculations by Use of an Extended Form of the Routh-Hurwitz Discriminant. S. Sherman, J. Di Paola, and H. F. Frissel. Methods are presented for determining the stability of the solution of the flutter polynomial by a finite (not approximate) calculation. The method is a generalization of Routh's and Hurwitz's discriminant to cover the case with complex coefficients. Use of the extended discriminant presented in this paper should save considerable time in flutter calculations. Further possibilities are opened for machine methods.

Full mathematical proofs and further development of these ideas are reserved for a later paper. Additional reports are planned applying the ideas to airplane and helicopter stability calculations. *Journal of the Aeronautical Sciences*, October, 1945, pages 385–392, 3 illus.

Buckling of Stiffener and Elastic Sheet Combinations Under Pure Bending. E. E. Weibel. Stiffened sheet covering, for example in seaplane hulls, may be subjected to bending moments that produce compressive bending stress in the unsupported stiffener areas. The critical value of bending moment is desired at which stiffeners of open section will buckle torsionally. The present solution introduces the effect of the elastic bending properties of the sheet into the stiffener buckling problem. The stiffener now carries a portion of the total moment plus a compressive force that is equal to the tensile force in the sheet. The expression for the elastic moments transmitted from the sheet is obtained by a linear treatment of the actually nonlinear problem. Goodier, in those problems considered by him, adds to the problems treated by Wagner and Kappus. He finds the critical loads or moments as the solutions of algebraic equations derived from the differential equations of the problem. In the present problem the sheet-bending deflection is expressed in the Levy type Fourier form, which avoids the differential equation in the variational problem and introduces a transcendental term into an otherwise algebraic equation. Trial-and-error solution is indicated to obtain the critical value of bending moment. *Journal of the Aeronautical Sciences*, October, 1945, pages 393–402, 8 illus.

Note on Analysis for Bending with Buckled Stringers. Edward A. MacLean. The writer offers a "short-cut" method for the analysis of a beam, such as a wing, made up of chord and stringer elements under a condition where there is a linear distribution of stress over a part of the section and where the remaining elements have buckled or crippled. It is suggested as an alternative for the step-by-step solution for this problem that has been in use for several years, in which the section properties must be determined each time an element reaches its maximum stress. It is assumed that the force in the buckled member can be determined or estimated. The suggested procedure is analogous to a method that was proposed by Odd Albert and others for the analysis of concrete columns. The bulkheads are assumed to retain their shape. Induced diagonal tension effects after buckling occurs are not considered. *Journal of the Aeronautical Sciences*, October, 1945, pages 403–407, 7 illus.

Plastic Bending—Approximate Solution. William R. Osgood. In two previous papers the exact solution of the plastic bending problem was considered. Since the exact solution is cumbersome, an approximation is desirable. This paper gives an approximate solution, which, in particular, makes it possible to determine slopes and deflections. The exact determination of these quantities is usually practically impossible in the plastic range. *Journal of the Aeronautical Sciences*, October, 1945, pages 408–420, 8 illus.

On the Dynamics of Elastic Buckling. J. H. Meier. The classic theory of elastic buckling is extended to give consideration to the time elements and inertia forces involved, in an endeavor to supply information concerning buckling under impact. In this article, time-deflection relations are investigated when an axial force is rapidly applied to a nearly straight bar. Distinction is made between two cases. In the first case the force applied is smaller than Euler's load for elastic buckling; in the second case it is greater.

The investigation is limited to cases where the center deflection of compressed bars stays relatively small with respect to the length of the bars. The curvature of the elastic line is therefore assumed to be proportional to the bending moment, independent of the slope. A rigorous analysis, using the strict equation for the curvature and considering inertia forces, would become unduly complicated. However, calculations show that a center deflection of 11 per cent of the original hinge distance increases the elastic buckling force by only 1.5 per cent, while the hinge distance is decreased by 3 per cent. The method of analysis set forth should therefore cover the large majority of practical cases.

Damping is not considered in this analysis. However, where it is of importance and the damping constants can be established, a correction factor for damping can be readily applied to the respective equations. *Journal of the Aeronautical Sciences*, October, 1945, pages 433–440, 4 illus.

Influence of Prestressing and Cyclic Stressing on Stress-Strain Characteristics of Magnesium Alloys. F. A. Rappleyea, R. E. Perry, and G. Ansel. The factors that produce Bauschinger effects in most metals operate in magnesium. In addition, the stress-strain curves of magnesium upon prestressing or cyclic loading are influenced by the mechanisms of deformation (slip and twinning) occurring in this metal. Data on the influence of prestressing and cyclic loading of wrought and cast commercial Dowmetal alloys are presented. The effects of recovery on the stress-strain curve are covered. The results are analyzed, and recommendations as to how to cope with the few problems caused by prestressing or cyclic loading are made.

A statement about DU PONT

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NYLON MOLDING POWDER—Another newcomer is *nylon* for use as a plastic. Nylon molding powder FM-1, for injection-molding, offers unusual toughness and a high service temperature, which under some conditions is as high as 380° F. Also, nylon retains its impact resistance at sub-zero temperatures. Its chemical resistance is better than that of most thermoplastics; nylon resists esters, ketones and alkalis. Nylon FM-1 has replaced bronze as a valve seat, holding high air pressure in U. S. Navy torpedoes. It has also been used for electrical coilforms in telephone headsets. Other uses will be tumblers, tableware, slide fasteners, and combs. A whole new field of use for nylon FM-105 is in extrusion jacketing of insulated wire, where it contributes resistance to abrasion and to gasoline and other organic solvents. Still other new nylon formulations provide a selection of outstanding properties for specific jobs—expanding the field of nylon applications, already varied.

"LUCITE"—"Lucite" methyl methacrylate resin returns from war with its virtues of transparency, good optical qualities, lightness in weight, proved by service in many critical applications. This plastic was used on many of our warplanes for enclosures, turrets, sighting domes, etc. So great was the Army's and Navy's demand that production was increased tenfold with *five* resultant price reductions. Builders of civilian airplanes will surely profit by their war experience with "Lucite." It does not discolor with age—in fact, you can expect "Lucite" to last for the normal life of the plane. Products made from "Lucite" are moisture-resistant, and are not affected by sunlight, alkalis, oils and dilute acids. Peacetime markets have stored up a huge demand for "Lucite"—to be used for compacts, medical instruments, television lenses, airport light lenses, sparkling display fixtures, decorative home furnishings—uses old and new.

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OTHER DU PONT PLASTICS—The war years saw those old reliables, "Pyralin" cellulose nitrate plastic and "Plastacele" cellulose acetate plastic, take on a wider variety of jobs, often saving weight and conserving precious metal. "Butacite" polyvinyl butyral resin, the tough plastic used as the interlayer of safety glass, has also been used successfully between sheets of "Lucite" to protect airplane enclosures of pressurized cabins against shattering. "Butacite" sheeting remains flexible and tough under a wide range of temperatures. In flake form, "Butacite" forms an excellent impregnating and waterproofing medium for fabrics; it is also used for fabric coatings (hospital sheeting, raincoats, etc.).

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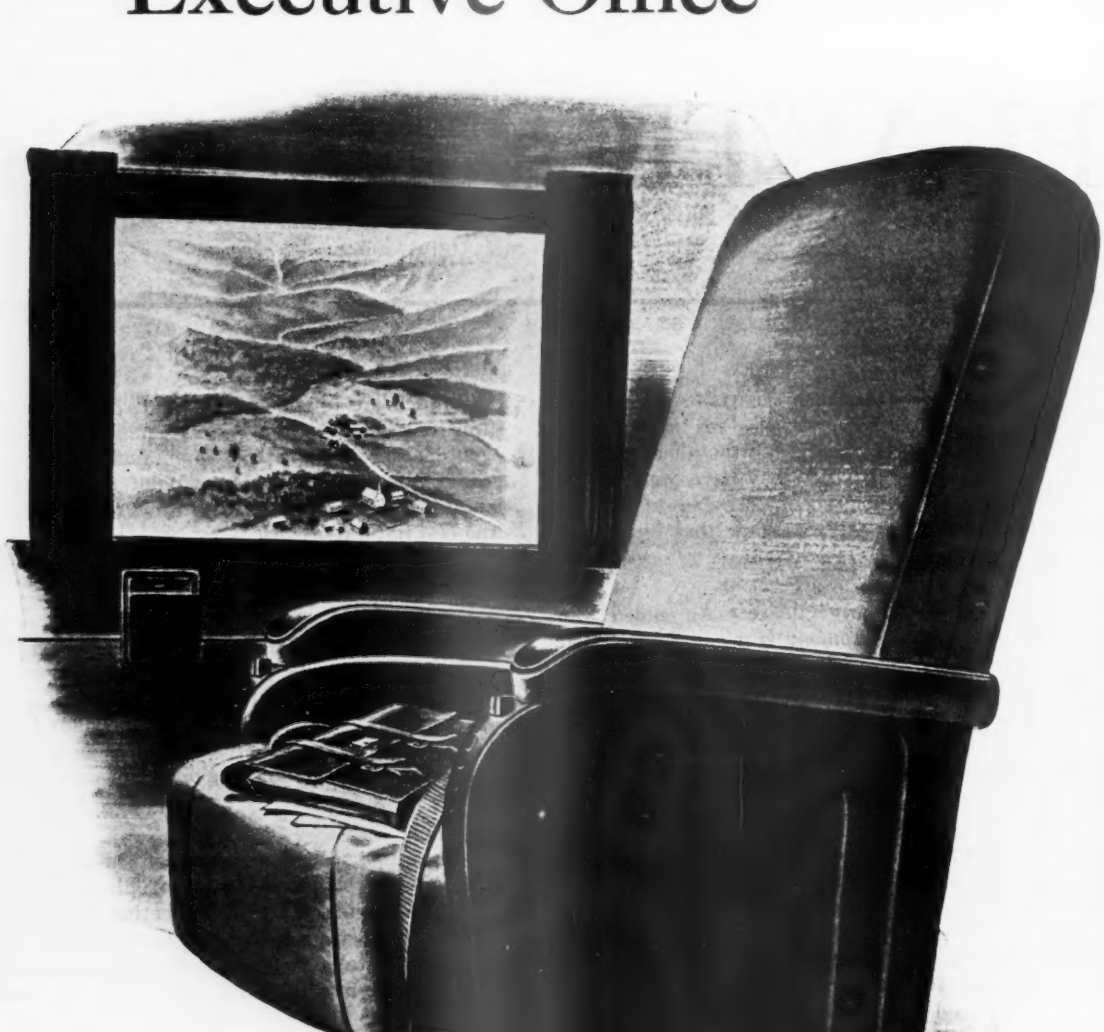

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This work demonstrates the following points: (1) In service, cyclic stressing at stresses up to the yield point will result in no harmful effects on the magnesium structure. (2) Accidental precompression loading of a magnesium-alloy structure beyond the yield strength is not detrimental to the strength of the structure upon reversal of stress. In the case of accidental pretension, immediate subsequent column action results in strengths slightly lower than the design values. (3) Any deleterious effects caused by forming or fabrication can be eliminated by appropriate treatments. *Journal of the Aeronautical Sciences*, October, 1945, pages 448–454, 460, 20 illus.

The Applicability of Saint-Venant's Principle to Airplane Structures. N. J. Hoff. It is common practice in engineering to disregard the local effects of loads and to calculate the stresses in elements of structures and machinery from formulas valid only at some distance from the region in which the loads are applied. Whenever this is done, use is made of Saint-Venant's principle either consciously or unwittingly. It is shown in the present paper that in thin-walled structures, like monocoque cylinders, the region in which the stresses are materially influenced by the manner in which the loads are applied may be extended enough to render conventional formulas entirely unreliable. *Journal of the Aeronautical Sciences*, October, 1945, pages 455–460, 8 illus.

Shear Lag and Torsion Bending of Four-Element Box Beams. R. E. Newton. A method of solution, consistent with the conventional assumptions of shear lag analysis, is developed for the axial and shear stress distribution in four-element box beams of the type frequently used in aircraft structures. Account is taken of the effects of shear lag, beam taper, skin cutouts, and the stresses due to restraint against torsional warping. There are no restrictions on the type of external loading.

The procedure is based upon the determination of a self-equilibrating set of "correction" stresses to be superposed upon the stresses calculated by conventional bending theory. The equations for the "correction" stresses are formulated as recurring pairs of finite-difference equations, which permits the handling of arbitrary variations of flange areas, web thicknesses, and external loads. Solution of the equations is performed by simple tabular calculations that may be done by a computer who does not understand the theory.

Numerical examples are presented for the stress distributions in a cantilever beam, with and without a mid-span cutout, under various external loadings. A simple means is provided for determining approximately the errors resulting from the use of finite increments of spanwise length, and it is shown that relatively large increments will normally give satisfactory accuracy. *Journal of the Aeronautical Sciences*, October, 1945, pages 461–467, 6 illus.

Instability of Extrusions under Compressive Loads. Walter Ramberg and Samuel Levy. Critical compressive stresses were computed and were compared with measured values for 26 different aluminum-alloy and magnesium-alloy extrusions.

Critical stresses for local instability were computed, considering the flanges as plates of uniform thickness rigidly clamped along one edge. Critical stresses for primary instability were computed from Kappus' theory of torsional instability, taking account of the stiffening effect of fillets and the effect on the torsion bending constant of bending stresses varying across the thickness of the wall. An estimate of the effect of plastic yielding was made by reducing the critical stresses in the ratio of reduced modulus, for a column of rectangular section, to Young's modulus. The measured and computed critical stresses for 120 of the 125 specimens differed less than 5,000 lbs. per sq.in. Comparison of strength-weight ratios for buckling and for failure showed that in general the Z-sections were most efficient.

A procedure is outlined for calculating buckling stresses of unsupported extrusions of one material from measured buckling stresses of similar extrusions of a different material. The procedure was checked by comparing calculated buckling stresses with measured buckling stresses for extruded T-sections, L-sections, and Z-sections of several aluminum and magnesium alloys. The differences between the measured and calculated buckling stresses did not exceed 10,000 lbs. per sq.in. The average difference was less than 5,000 lbs. per sq.in. *Journal of the Aeronautical Sciences*, October, 1945, pages 485–498, 14 illus.

Photo-Elasticity and Design Problems. Part II. R. B. Heywood. This is the second and concluding installment of an article on stress determination by photoelastic analysis. Applications of the method are described to illustrate the results that it is possible to obtain by this technique and to reveal the practical advantages of the method. Among the types of stress concentration studied are such examples as a beam with a small notch, a cantilever subjected to pure bending, a hole in a tensile member, an interference plug in a tensile member, and a diamond-shaped hole under shear stress. Mention is made of the use of the technique in the development of the Rolls-Royce Merlin engine, but conditions of secrecy prevent the publication of details. *Aircraft Engineering*, August, 1945, pages 226–228, 10 illus.

Cumulative Damage in Fatigue. Milton A. Miner. In this investigation the assumption was made that the phenomenon of cumulative damage under repeated loads is related to the net work absorbed by the specimen. Then the number of loading cycles applied, expressed as a percentage of the number of cycles required to produce failure at a given stress level, would be the proportion of useful life expended. When the total damage, as defined by this concept, reached 100 per cent, the fatigue specimen should fail. Experimental verification of this concept for an aluminum alloy, using different types of specimens, various stress ratios, and various combinations of loading cycles is presented. These data are also analyzed to provide information concerning different stress ratios when an S-N curve for any ratio is known. Results of a sample analysis based on experiments are given. It is concluded that a simple and conservative analysis is possible, using the concept of cumulative fatigue damage. *Journal of Applied Mechanics*, September, 1945, pages A-159–A-164, 14 illus.

Properties and Characteristics of 24S-T Aluminum Alloy Rivets. W. T. MacDonald and M. E. Tatman. To determine the driving characteristics, shear strengths, and corrosion resistance of 24S-T aluminum-alloy rivets, the tests reported in this article were conducted. Data are supplied regarding the force required to squeeze-drive rivet heads, the effect of driving time on cracking, the corrosion resistance of artificially aged rivets, and shear strengths. *Product Engineering*, September, 1945, pages 625–627, 1 illus.

Unsymmetrical Bending and Strut Design. A. N. Kinkead. Methods for calculating the maximum fibre stress in beams subjected to unsymmetrical bending are explained. Part I of the article deals with the theory; Part II with the application of the theory to the design of airplane struts. The writer develops formulas for computing the values of fibre stress from which curves are plotted for obtaining the allowable stress coefficient for varying angles of loading in beams of I-section, U-section, T-section, channel-section, and angle-section, subjected to unsymmetrical bending.

In the part dealing with the theory, two examples are worked out, one referring to a beam problem in structural work, using a steel beam of I-section, measuring 12 in. by 8 in., and the other using a light alloy aircraft component of channel section, measuring 1.8 in. by 0.8 in. In the second part, two examples are given, the first requiring the calculation of the strength of a 1 in. by 1 in. by $^1/_8$ in. curved duralumin flap-support rib member of equal angle section. The second shows how to estimate the strength of a T-section boom measuring 6 in. by 6 in. by $^1/_2$ in. It is stated that the method may be applied to sections of shapes differing from the four common types of engineering sections dealt with, and that the formulas evolved should obviate the necessity for graphical construction in unusual problems. *Aircraft Engineering*, August, 1945, pages 232–236, 13 illus.

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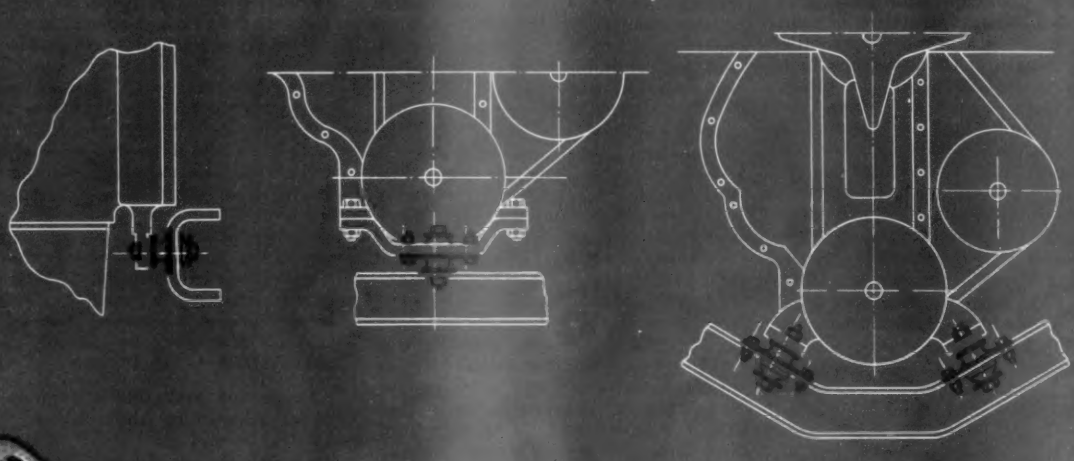

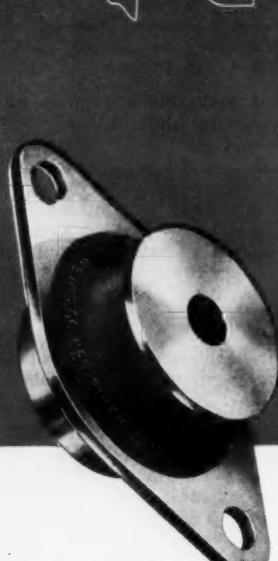

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Formulas for Strain Energy and Related Quantities. Alfred S. Niles. Formulas are presented which will save computation labor in least-work analysis and beam-deflection computations. These formulas were obtained by carrying out the integrations for some of the more common types of loading. They express the strain energy and the quantity of a beam segment in terms of its end moments and the intensity of transverse load. The work of evaluation is thus reduced to substitution of numerical values in formulas that can be handled by anyone with a knowledge of simple algebra. The use of the formulas is illustrated by their application to an example cited in an earlier article by the writer. *Industrial Aviation*, September, 1945, pages 22, 23, 87, 1 illus.

The Strength of Alclad D.T.D. 390. I. G. Bowen. The frequency distribution of strength of Alclad sheet made to specification D.T.D. 390 is studied. The writer describes tests that were first conducted to ascertain how far the sample was representative of the whole range of data for the material. The tests indicated that an analysis of the frequency distribution should yield results that would be fairly representative of the period of production from 1941 to 1944. He then compiles the distributions of the proportionality limit, the 0.1 and 0.2 and 0.5 per cent proof stress, the ultimate tensile strength and the elongation.

Theoretic frequency curves are then fitted to these distributions and the results are illustrated diagrammatically. From the theoretic curves it is possible to define the lower limits of strength corresponding to different probabilities. *Aircraft Engineering*, August, 1945, pages 240, 241, 7 illus.

Superchargers

Some Advantages and Limitations of Centrifugal and Axial Compressors. Kenneth Campbell and John E. Talbert. The writers evaluate the relative merits of centrifugal and axial flow compressors. They give a detailed report of the results of extensive tests of compressors used as superchargers for reciprocating engines and in nonreciprocating power plants, relative to the effects of compressor efficiency on the performance of the power plant. They review briefly the laboratory work carried out by Wright Aeronautical Corporation over a period of 10 years, including the design details and performance figures submitted by the company to all manufacturers of engines and superchargers in the United States and to British representatives.

A comparison is made of the two types on the basis of pressure ratio and operating range, with lengthy explanations of the effects of design changes in the various components of the supercharger, and comments concerning the limitations governing the design of the different parts. It is noted that in many cases compromises are necessary to meet the specific requirements and limitations of a particular installation, and that for nonreciprocating power plants optimum performance of the compressor is of greater importance by a wide margin than other considerations. The conclusion is that the axial compressor will probably be used ultimately in applications where compressor efficiency above 80 per cent is of paramount importance. *Industrial Aviation*, September, 1945, pages 50, 52–54, 56, 82–86, 15 illus.

Fairey Aviation Company's tube expander. This exploded view shows the tapered steel rollers and split cage. Three of the rollers have been removed for illustration purposes.

Turbo-Supercharger Speed Control. M. Allen. A theoretic analysis is made of the acceleration time for a turbosupercharger and of the factors influencing the control. The differential equation expressing the relationship of time and speed of the supercharger is developed from the assumption that the supercharger has speed characteristics similar to those of a commercial fan or blower. The constants are determined by substitutions in the equation, and the solution of the equation is explained.

Three theoretic time-response curves are plotted and illustrated, the curves being based on assumptions with regard to the power input, the efficiency of the supercharger, and the induction air-stream velocity. Results of changes in the power input to the supercharger are studied, this being practically the only factor susceptible to control by the pilot. The sequence of events in making such a change is traced.

It is concluded that control of the waste-gate opening is critical and that an automatic regulator containing an accelerating-limiting device is desirable. *Aero Digest*, September 1, 1945, pages 145, 146, 192, 2 illus.

Testing Equipment

Resistance Wire Strain Gage Equipment for Static and Dynamic Testing. W. F. Gunning and E. G. Van Leeuwen. A description is given of the specialized equipment used with wire strain gages for static and dynamic testing at the research laboratories of the Douglas Aircraft Company, Inc. The instruments are evaluated with respect to their limitations and field of application. Particulars are given about a precise method of gage calibration which is applicable to all measuring systems. *Product Engineering*, September, 1945, pages 608–613, 8 illus.

Tools and Equipment

New Automatic Riveting Machine. The construction, operation, and advantages of the Drivmatic Automatic Riveting Machine are indicated. A product of the General Engineering Company, and used in the manufacture of air frames by Beech Aircraft Corporation, the Drivmatic performs automatic riveting of assemblies that are too heavy for the punching and dimpling process. It gages the combined metal thickness, drills and countersinks the hole, then selects, inserts, and heads one of five lengths of rivets of the same head style and body diameter. With the Drivmatic, the combined metal thickness may be as great as $^3/_8$ in. However, the machine may also be tooled to handle all common head styles of aircraft rivets from $^1/_8$-in. to $^1/_4$-in. body diameter. *Aero Digest*, September 1, 1945, pages 120, 121, 6 illus.

Application of Nusite—A Specially Heat-Treated High-Speed Steel. Arthur A. Schwartz. In a brief article the writer reports on how a specially heat-treated high-speed steel known as Nusite is being used to advantage in three factories of the Bell Aircraft Corporation. It is explained that Nusite fills a definite need for a tool steel ranking between the high carbides and the regular high-speed steels.

Particulars are given regarding the way Nusite tools should be applied. *Machinery*, September, 1945, pages 186, 187, 1 illus.

Simpler and Faster. A simplified procedure for adjusting the aileron control cables in DC-3 transport planes, developed by employees of United Air Lines, is explained. The procedure is stated to save many man-hours of labor. Three jigs were devised, one to fit over the control wheels to hold them in neutral position; another to lock the center bell crank; and a third to lock the inboard bell crank in neutral. With the controls thus locked, the cables are adjusted quickly and effectively. *Air Transport*, September, 1945, pages 53, 54, 4 illus.

Expansion. The design, construction, and applications of a special tube expander are noted. Developed by the Fairey Aviation Company, Ltd., to obviate individual fitting work, this device is intended primarily for truing-up the bore of a tube in order to accommodate a plug-end of fixed size. It consists essentially of a cage of parallel rollers that are tapered slightly at their leading ends and are inclined laterally at a few degrees to the axis of the tool shank. *Flight*, August 30, 1945, page 226, 2 illus.

The CONTROL CABLE for the

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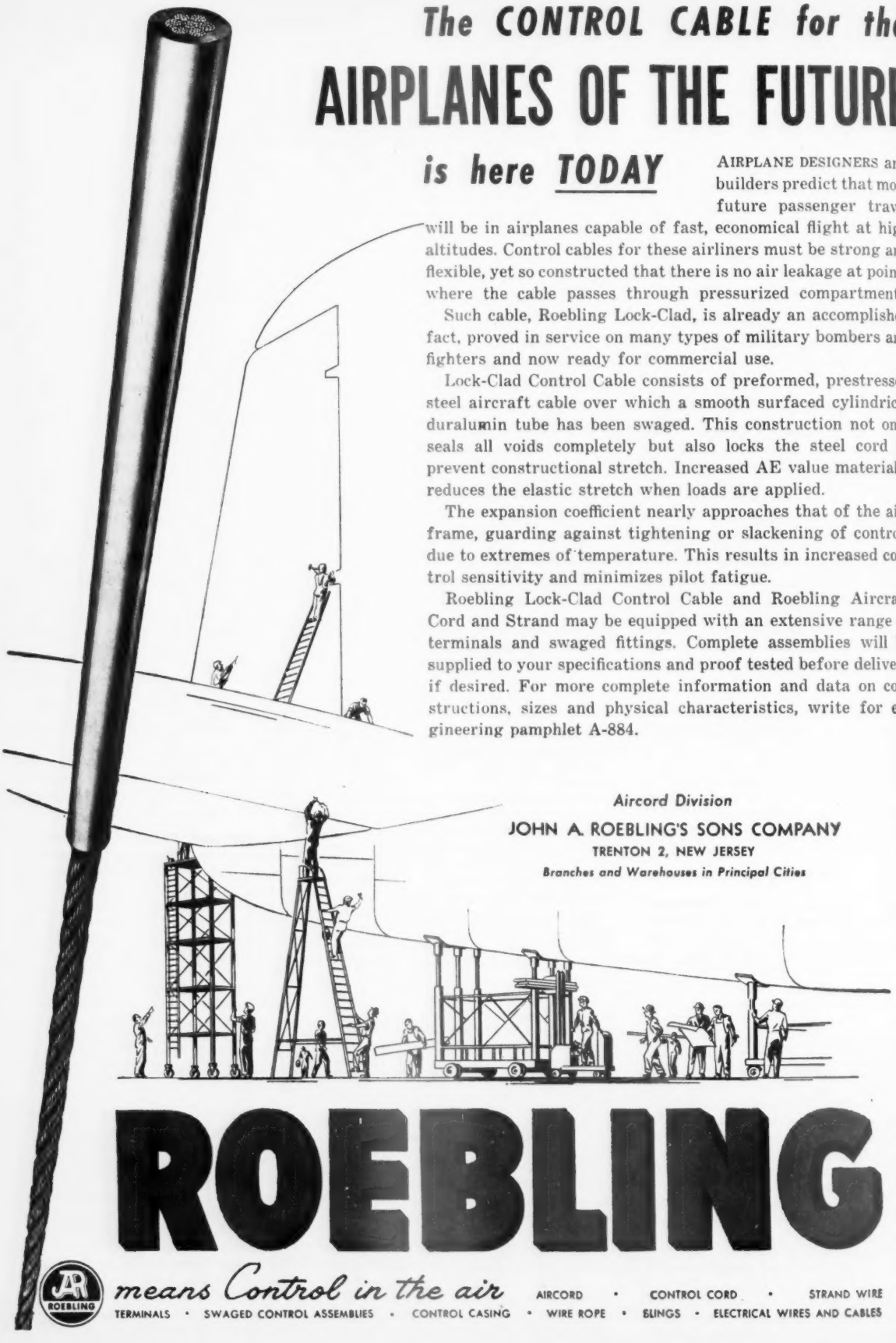
AIRPLANE DESIGNERS and builders predict that most future passenger travel will be in airplanes capable of fast, economical flight at high altitudes. Control cables for these airliners must be strong and flexible, yet so constructed that there is no air leakage at points where the cable passes through pressurized compartments.

Such cable, Roebling Lock-Clad, is already an accomplished fact, proved in service on many types of military bombers and fighters and now ready for commercial use.

Lock-Clad Control Cable consists of preformed, prestressed steel aircraft cable over which a smooth surfaced cylindrical duralumin tube has been swaged. This construction not only seals all voids completely but also locks the steel cord to prevent constructional stretch. Increased AE value materially reduces the elastic stretch when loads are applied.

The expansion coefficient nearly approaches that of the airframe, guarding against tightening or slackening of controls due to extremes of temperature. This results in increased control sensitivity and minimizes pilot fatigue.

Roebling Lock-Clad Control Cable and Roebling Aircraft Cord and Strand may be equipped with an extensive range of terminals and swaged fittings. Complete assemblies will be supplied to your specifications and proof tested before delivery if desired. For more complete information and data on constructions, sizes and physical characteristics, write for engineering pamphlet A-884.



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Training

Reconversion of Military Pilots. Charles A. Selby. The writer reports that, contrary to expectations, ex-combat pilots are proving to be the best copilot trainees the air lines have ever had. He commends the ex-military pilots for their fine mental attitudes and cooperation as air-line pilot trainees, but notes some of the technical difficulties they are commonly experiencing in adapting themselves to civilian aircraft. Among these difficulties are overcontrolling on both elevators and ailerons and a tendency to "fight" the instruments. *Air Facts*, October, 1945, pages 44–46, 48, 49.

Aviation Goes to College. Paul Fountain. Purdue University's program for aviation training is outlined. It is reported that, beginning in November, 1945, Purdue will initiate revised curriculums leading to bachelor and graduate degrees in aeronautical engineering and an entirely new curriculum leading to a bachelor degree in air transportation. Information is given as to what these courses will consist of and how they will be conducted.

A schedule of the five flight-training courses available at the University's airport is included. *Flying*, October, 1945, pages 32, 33, 84, 86, 87, 6 illus.

Canadian Training for Glider Pilots. Hugh Kemp. This article is about the Central Gliding School at Carp, Ont., sponsored by the Air Cadet League of Canada for the purpose of training a nucleus of instructors and ground engineers for Canada's gliding program. It contains data relative to the school's location, facilities, equipment, enrollment, syllabus, and teaching and administrative personnel. Training courses noted include those preparing the students for positions as gliding instructor, construction supervisor, and glider pilot, in addition to a general familiarization course. *Canadian Aviation*, September, 1945, pages 56, 57, 86, 88, 4 illus.; "Central Gliding School," *Canadian Air Cadet*, August, 1945, page 8, 2 illus.

The Airline Mechanic. Allan Merkin and Albert G. Thomas. The prerequisites for a successful air-line mechanic are outlined. Sections deal with qualifications, duties, responsibilities, and the opportunities available in this line of work. Tables list the qualifications for the four grades of each group of aircraft mechanics—engine, accessories, instrument, sheet-metal, and propeller. *Air Transport*, September, 1945, pages 42, 44, 47, 48, 51, 2 illus.

Welding

Aluminum Brazing. W. E. Brainard. Information that has been accumulated about the process of aluminum brazing is recorded, with particular reference to the use of the method in aircraft manufacture. Cost savings that have been made possible through the application of advanced methods of brazing aluminum and magnesium are described. A typical example is an assembly in which the production rate was 100 parts in 12 hours by old methods, and 100 parts in 14 min. by the brazing method. It is observed that brazing inherently possesses the same difficulties of inspection as welding, in that a good surface appearance does not necessarily guarantee fusion soundness throughout the brazed section. Until recently, there seemed to be no method of process control sufficiently exacting to ensure joints free from inclusions of foreign matter. For that reason the safey factors, including an ignorance increment, were necessarily high. Particulars are given about methods developed by the Vultee Field Division of the Consolidated Vultee Aircraft Corporation which appear to have overcome this obstacle. The three processes used in aluminum brazing are defined as the torch, furnace, and flux-dip methods, each of which is outlined, with a comparison of the work accomplished. Numerous examples of brazed aluminum work are described at length. *Machinery*, September, 1945, pages 143–152, 21 illus.

Resistance Welding. Part II. R. W. Ayers. Second installment of a three-part article surveying modern developments and practical applications of resistance welding to aircraft construction. Part II continues the discussion of spot welding with an examination of equipment for spot-welding light alloys. The principles, characteristics, advantages, and applications of stitch welding and projection welding are explained. Machines employed for stitch and projection welding are described. Illustrations demonstrate both processes in detail. The examples given tend to deal with projection welding as an economical and improved method of spot welding, but certain different applications of projection welding are noted as well.

The spot-welding equipment reviewed includes ignitron timers and stored-energy machines of two types: (1) machines storing energy by electromagnetic means, and (2) those using condensers. *Aircraft Production*, September, 1945, pages 446–450, 16 illus.

Properties of Gas Welds in Three Alloys of Sheet Magnesium. W. H. Jones. The writer outlines the advantages of Dow "M" magnesium or its equivalent for gas-welded parts. The report is based on the results of an investigation of weld properties, welding procedures, and heat-treatment for production assemblies, with reference to test specimens of three magnesium alloys. How a compromise was made to obtain good corrosion resistance and adequate strength, and to minimize hot-shortness, is described. *Product Engineering*, September, 1945, pages 580, 581, 5 illus.

The Welding of Non-Ferrous Metals. Part VI. E. G. West. The sixth installment of this article is devoted to resistance-welding equipment, principles, and control methods as applied to the nonferrous metals. Consideration is given to alternating-current machines and their control, condenser-discharge welding machines, and induction storage machines. Reference is made to variations of these three chief types of machines which have been developed. *Sheet Metal Industries*, September, 1945, pages 1618–1622, 1624, 12 illus.

Changes of Address

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TINY GIANT WITH A HISTORY

Long before the war, the men who design your Bell Telephone System were looking for an electron tube with frequency capabilities never before attained. With it, they could transmit wide bands of telephone messages — several hundred of them — simultaneously through coaxial cable—economically, and over long distances.

They developed a tube which set a new standard in broad-band, high-frequency amplification. So minute that its electrode system had to be inspected under a magnifying glass, the tube could amplify either the voices of 480 people talking at the same time, or the patterns of television. Long-distance, broad-band transmission became a commercial reality.

6AK5

Cross-section of Electrode System (five times actual size)

When war came, this tube excelled all others as an amplifier in certain military equipment. It then grew into the 6AK5, one of the great little tubes of the war. Besides producing 6AK5's in large quantities, the Western Electric responded to emergency needs of the Army and Navy by furnishing design specifications and production techniques to other manufacturers, of whom at least five reached quantity production. On every battlefront it helped our ships and planes to bring in radio signals.

Developing electron tubes of revolutionary design has been the steady job of Bell Laboratories scientists ever since they devised the first practical telephone amplifier over thirty years ago. Now tubes like the 6AK5 will help speed the living pictures of television, as well as hundreds of telephone conversations simultaneously over the coaxial and radio highways of the Bell Telephone System.

BELL TELEPHONE LABORATORIES

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Government Publications

Army Air Forces

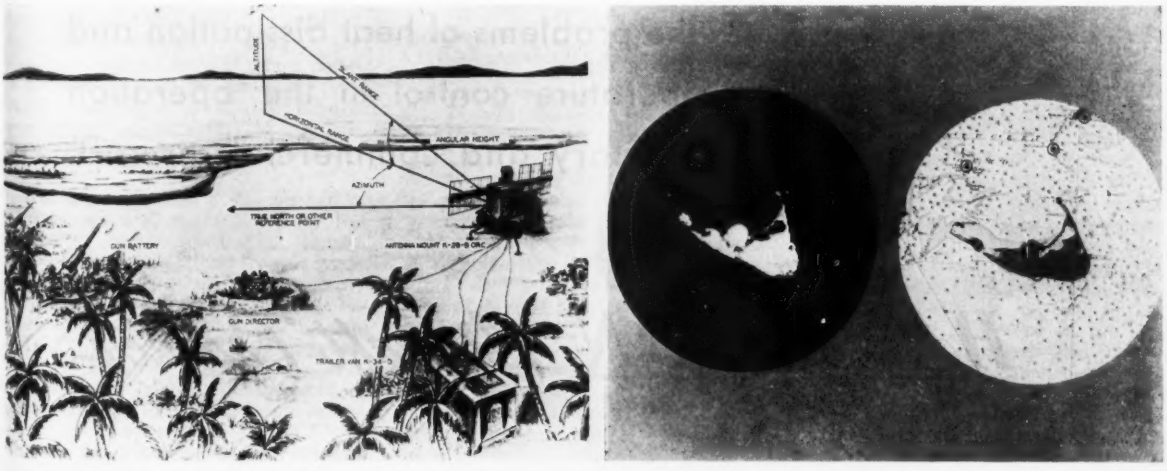
Development of Radar. Recent relaxation by the War Department of the secrecy surrounding radar permits telling the story of radar's part in protecting this country and England against enemy aircraft attack. Activity in the engineering of radar equipment for use in the operations of the Army Air Forces was centered in the Radio and Radar Subdivision of the Air Technical Service Command at Wright Field. The Aircraft Radio Laboratories at Wright Field and the Watson Laboratories, located at Eatontown, N.J., under the technical supervision of the Radio and Radar Subdivision, have been responsible for guiding the direction of radar research in Government, university, and commercial laboratories, adapting theoretic research results to the solution of engineering problems, directing the quantity production of millions of dollars of radar equipment, and fitting the complicated devices into A.A.F. aircraft and vehicles as workable systems.

Air-borne radar equipment of major significance made available to the A.A.F. through the efforts of the A.T.S.C. included search equipment that contributed largely to the defeat of the German submarine; bombing devices that permitted bombardment raids over enemy territory regardless of weather or visibility conditions; lightweight, portable beacons used as navigating systems; precision navigation equipment used for exact location of drop zones or strategic targets, and for long-range navigation over water and poorly marked land areas; altimeters providing accurate readings indicating altitude above the terrain; air-borne interception devices used by night fighters to locate and intercept enemy night raiders; devices to facilitate rescue of air crews downed at sea or in dense jungles; tail-warning equipment to give fighter pilots warning of enemy attacks from the rear; air-borne gun-sighting and gun-laying devices providing automatic control and firing of air-borne machine guns and cannon; devices used for the low-altitude bombing of shipping; and system tie-ins with optical bombsights, permitting synchronous operation of radar bombing sets and optical bombsights.

The laboratories have also made available to the A.A.F. the following types of radar equipment: long-range, early-warning equipment for the detection, from the ground, of enemy aircraft, indicating range, height, and azimuth; ground-control interception devices plotting the course of enemy aircraft and directing defensive operations, either ground-based or from friendly aircraft already in flight; ground-control approach installations enabling ground crews to inform pilots of their location with respect to overcast runways and to guide them to safe landings; and equipment to mark clearly the front lines and enemy targets enabling the A.A.F. to concentrate its striking force in the support of ground troops. *Air Technical Service Command.*

Radio-Controlled Target Airplane. Restrictions have been removed from the publication of information about one of the Army's most ingenious training devices, the radio-controlled, pilotless target airplane developed at Air Technical Service Command Headquarters at Wright Field.

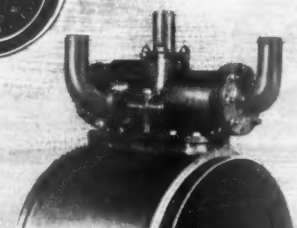
Able to fly at speeds ranging from 100 to 200 m.p.h. and at altitudes up to 3,000 ft., controlled by radio from the ground, the target airplane is the result of 8 years of intensive research work by the Control Equipment Branch, Equipment Laboratory Staff. Two models are now standard equipment for the Army Air Forces, the OQ-3 and OQ-14. They are used as targets for aerial gunnery practice by B-29 gunners and for antiaircraft practice by ground forces. The Navy is using the radio airplane target in its training program for automatic weapons' target practice aboard combatant ships. Navy officers and enlisted personnel have been trained in the operation of the pilotless airplane. The radio airplane target has recently found another use, as a training aid for students of radar in tracking flying objects in the air for gunnery practice.



Applications of radar. *Left,* radar control of anti-aircraft artillery fire is illustrated in this sketch of a radar set supplying firing data to a gun director. *Right,* another use shows an aerial radar-scope photograph of Nantucket as compared with an actual chart of the island.

HARRISON

Temperature Engineering



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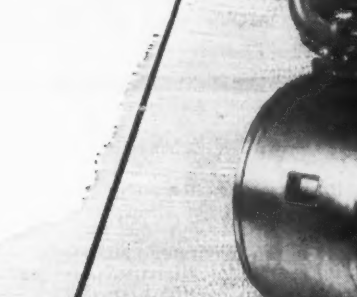

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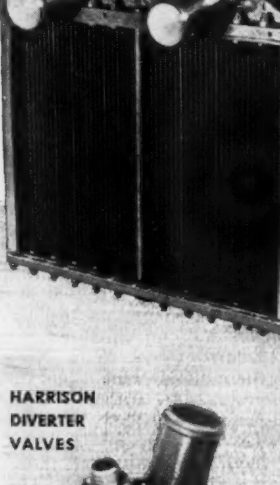

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HARRISON *Aircraft Products*

HARRISON RADIATOR DIVISION OF GENERAL MOTORS, LOCKPORT, NEW YORK

Manufactured by the Radioplane Company, Van Nuys, Calif., and Globe Corporation, Aircraft Division, Joliet, Ill., the OQ-3 airplane target is a high-wing monoplane, 9 ft. long, with a wing span of 12 ft. 3 in. It weighs 100 lbs. and is capable of flying 103 m.p.h. It is constructed of welded steel tubing covered with airplane cloth. The power plant is an 8-hp., 2-cylinder, 2-cycle gasoline engine. The OQ-14, a later model, has a wing span of 11 ft. 6 in. and is powered by a 22-hp. engine. This model will fly at 140 m.p.h.

Take-off is accomplished by the use of a catapult, powered by compressed spring coils or rubber shock cord. After launching, the target is radio-controlled and is operated by elevator and rudder controls only. Landing is made by parachute, released either by the control operator or automatically as a result of damage from vital hits. The elevator and rudder servo controls remain in effect after the engine is stopped and the parachute released, providing the radio has not been damaged, so that "dead-stick" landings may be made in the event the parachute attachments are shot away.

The basic system of radio control for the target involves the use of an ultra-high-frequency carrier wave, modulated by five different audio frequencies. A small control box attached to the transmitter by means of a flexible extension cable, equipped with a stick to simulate actual airplane control, is used to select the proper radio signals. Four audio-frequency tones are used to control the target airplane in flight, one each for left, right, up, and down. A fifth frequency centers the rudder and releases the parachute. Only one of these audio frequencies is used at a time. When one of the control frequencies is not in use, the fifth, or parachute frequency, is automatically switched on.

Installed in the plane is a radio receiver selector, which translates the radio waves and actuates the servo unit in the airplane by electrical energy. The servo unit provides the mechanical action to control the elevators and rudder. Operation has been so simplified that anyone without previous experience can learn to fly the target plane in 6 hours. Use of the plane has provided a realistic target to student gunners because of its ability to simulate flight attitudes, dives, and evasive action.

The first experimental models had a 3-hp. engine with counterrotating propellers to counteract torque, square cross-section fuselage, and tricycle landing gear. The method of control included a telephone dial. Experiments, tests, and further development by the A.T.S.C. finally eliminated the counterrotating propellers, landing gears, and telephone-dial control. Torque action was eliminated through design incorporating inherent stability. With the use of steel tubes for the framework, the landing gear became unnecessary since the rugged construction of the airplane absorbed the landing shock. Experimentation with the planes is still being carried on at A.T.S.C. headquarters, Wright Field. *Air Technical Service Command.*

Experiments to Prevent Fire Hazards in Aircraft. In order to prevent fire hazards in engine nacelles, the A.T.S.C. Engineering Division is conducting experiments in its Power Plant Laboratory to test the comparative fire resistance of all types of fuel and oil hoses and lines forward of the fire wall, and of all equipment in the accessories section of the nacelles. The investigation seeks to discover how to prevent fire hazards from incendiary bullets and from other causes while the plane is in operation in the air, and to develop new equipment and material that will withstand the intense heat of such fire long enough for the fire to be extinguished before it can spread and cause an explosion.

The experiments simulate the actual aircraft installation insofar as gasoline and oil flow and pressure are concerned. The test specimen is mounted in the test stand, and when the desired flow and pressure are obtained, the flame of a kerosene torch, generating an intense heat, is directed against the hose while the gasoline is being pumped through the system. Flame temperature is determined by chromel-alumel thermocouples located on the test specimen at the point of contact with the flame. Fire control is maintained by the use of a portable carbon-dioxide unit connected directly with the test chamber and operated manually from the control panel. In this manner, the fire resistance of aircraft hose of all specifications and of aluminum lines is determined.

One of the practical results of the tests has been the development of a special aircraft hose that will withstand the intense heat for a period of 30 min. or more, as against the 3 min. period for previous hoses. In an effort to find a method of protecting fuel and oil hoses and lines on aircraft in service, several types of flame-retarding coverings were used. *Air Technical Service Command.*

Civil Aeronautics Administration

Flight Instructors to Give Private Pilot Tests. To speed up the process of obtaining private pilot certificates, the C.A.A. is now permitting flight instructors to give the written examinations to applicants. The examination, which students take prior to their first cross-country flight, is given on Parts 43 and 60 of the Civil Air Regulations, which deal with general operational rules of aircraft and traffic rules of the air. Questions are of the multiple-choice type and are supplied by the C.A.A. under carefully controlled conditions to prevent their "leaking" in advance. Instructors use a C.A.A. grading sheet to mark the student's paper.

Flight instructors are also eligible for designation as Private Pilot Flight Examiners and, as such, they are qualified to give the flight tests that students must pass to obtain private pilot certificates. C.A.A. inspectors in the field recommend instructors for this designation and frequently give the instructor a temporary designation. Final designation comes from the Washington office of the General Inspection Division. These examiners are being appointed as fast as conditions permit, in an effort by the C.A.A. to catch up with the growing backlog of applicants waiting for flight tests.

Private pilot flight tests are given free by C.A.A. inspectors but since they must work on a crowded schedule and cannot visit the airports in their districts often enough to give fast service to applicants, qualified instructors have been designated Flight Examiners and are permitted to charge $5 for giving a private pilot's flight test. *Office of Aviation Information.*

Postwar Plans of Airforce Returnees. According to a survey made by the C.A.A. in cooperation with the Army Air Forces, based on a questionnaire submitted to a group of A.A.F. officers and enlisted men upon their return from overseas service, it is estimated that 441,000 veterans of the A.A.F. intend to seek employment in aviation and 87,000 of them desire to purchase personal planes. The estimate was made by projecting the answers given by 1,278 officers and 2,215 men at an eastern personnel distribution center, against the total number of men in the A.A.F. at the time.

Numerous other facts are brought out in a detailed analysis of the replies which has been prepared for distribution under the title indicated. Copies of the analysis are available from the *Office of Aviation Information*, Washington, D.C.

Civil Aeronautics Board

International Standardization of Dimensional Units. The Civil Aeronautics Board has distributed a questionnaire and commentary concerning proposed international standardization of units of measurement, in order to facilitate transmission of information in international flying operations.

After a brief explanation of the difficulties arising through the varying units of measurement prevalent in different countries and parts of the world, the Board has requested expressions of opinion on three questions, the substance of which follows: (1) Should the meter be substituted for the foot as the normal unit in the measurement of altitude, as used in the graduation of altimeters, in the issuance of traffic clearances and instructions, and in giving meteorologic information? (2) Should the statute mile be replaced either by the nautical mile or by the kilometer in measuring distance and speed, including wind speed? (3) Should the kilogram be substituted for the pound in giving airplane weights and load limits?

YORK

Although the questions and comments are primarily intended to apply to the units of measurement used directly in air navigation, it is noted that advantages would be obtained through similar standardization in mechanical practice. *Civil Aeronautics Board Draft Release No. 1*, September, 1945.

Changes in Airworthiness Requirements. The Civil Aeronautics Board has reached a decision on several important points relating to the airworthiness requirements for transport aircraft, following a 5-day hearing of interested parties which was concluded on September 14.

A complete text of these new regulations (CAR Part 04) will be issued in the near future but the decision reached is being announced without waiting for the completion of the full text of the revised part so that manufacturers of transport aircraft may proceed with their new designs in accordance with the new regulations and without delay.

The Board's decision provides in substance that: (1) The new regulations become effective optionally as of the date of adoption of the new Part. Compliance therewith will be mandatory for types of which the prototype is first flown on or after January 1, 1948, except in those cases where the Administrator finds that the design was well advanced at the time of adoption of the new regulations and that the subsequent delay was beyond the manufacturer's control. (2) Fixed limit on stalling speed is removed in favor of more realistic limitations. (3) Minimum climb requirements in the cruising configuration, whether with full power or with one or two engines stopped, shall be met with the cowl flaps set for adequate engine cooling under the "standard hot-day condition." (4) There shall be a minimum rate of climb in the cruising configuration with all engines operating at maximum continuous power. (5) The minimum rate of climb with one engine inoperative under given conditions shall vary with the gross weight of the airplane, as indicated. (6) For airplanes with four or more engines there shall be a minimum rate of climb in the cruising configuration with two engines inoperative and with maximum continuous power on the remaining engines.

Other provisions are as follows: (7) Clear and distinctive stall warning shall be apparent to the pilot at a speed at least 5 per cent above the stalling speed with flaps and landing gear in any position and in either straight or turning flight. (8) Aircraft may be certificated at a take-off weight not in excess of 105 per cent of the landing weight taken without the means for dumping fuel. Higher take-off weights not in excess of 130 per cent of the landing weight may be authorized provided it is possible to jettison fuel according to specified requirements. (9) There shall be no separate requirements establishing a cargo category at this time because of the lack of convincing evidence in justification of two separate standards of airworthiness for passenger and cargo aircraft.

The Board then sets forth the most significant factors upon which it based its decision to eliminate a fixed stalling speed limit. These are given under seven headings dealing with (a) the evolution of aircraft design by which stalling speeds have steadily increased; (b) the elimination of fixed stalling-speed limits is consistent with practice in other countries; (c) the increased stalling speed allowed under the regulations has been kept reasonably in step with the design trend; (d) fixed minimum stalling-speed limits impose an unjustifiable limitation on design; (e) air-transport safety records justify higher stalling speeds; (f) and (g) outline other limitations as compensating factors.

Department of Agriculture

Data on Woods. Numerous additional reports have been made available in the series issued in cooperation with the Army-Navy-Civil Committee on Aircraft Design Criteria, under the supervision of the Aeronautical Board and in cooperation with the University of Wisconsin. They are as follows:

Supplement to Buckling of Flat Plywood Plates in Compression, Shear, or Combined Compression and Shear: Effective Width of Thin Plywood Plates at Maximum Load in Compression with the Face Grain at 0°, 15°, 30°, 45°, 60°, 75°, and 90° to Load, No. 1316-1.

Strength and Related Properties of Forest Products Laboratory Laminated Paper Plastic (Papreg) at Normal Temperature, No. 1319.

Supplement to Compression, Tension, and Shear Tests on Yellowpoplar Plywood Panels of Sizes that Do Not Buckle with Tests Made at Various Angles to the Face Grain: Tension Tests, No. 1328-B; Shear Tests, No. 1328-C.

Effect of Hydraulic-Equipment Oils on the Bending and Compressive Strength of Sitka Spruce, No. 1520.

A Comparison of Shearing Strengths of Glued Joints at Various Grain Directions as Determined by Four Methods of Test, No. 1522.

Bolt-Bearing Strength of Wood and Modified Wood: Bolt-Bearing Strength of Laboratory-Made Cross-Banded Yellow Birch Compreg Under Aircraft Bolts, No. 1523-A.

Buckling Loads of Flat Sandwich Panels in Compression; Various Types of Edge Conditions, No. 1525.

Effects of Variations in Design on the Strength of Some Typical Glued Fastenings in Wood Aircraft, No. 1526.

Effect of Thickness of Plywood Reinforcing Plates on the Behavior of Solid Wood Aircraft Spars Under Changes in Moisture Content, No. 1527.

Elastic Properties of Wood: The Young's Moduli, Moduli of Rigidity, and Poisson's Ratios of Balsa and Quipo, No. 1528.

Buckling of Thin-Walled Plywood Cylinders in Torsion, No. 1529.

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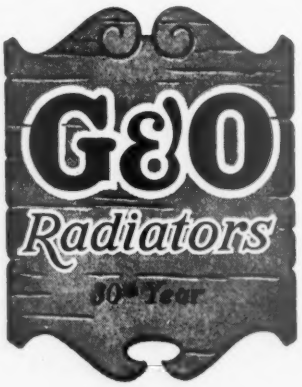

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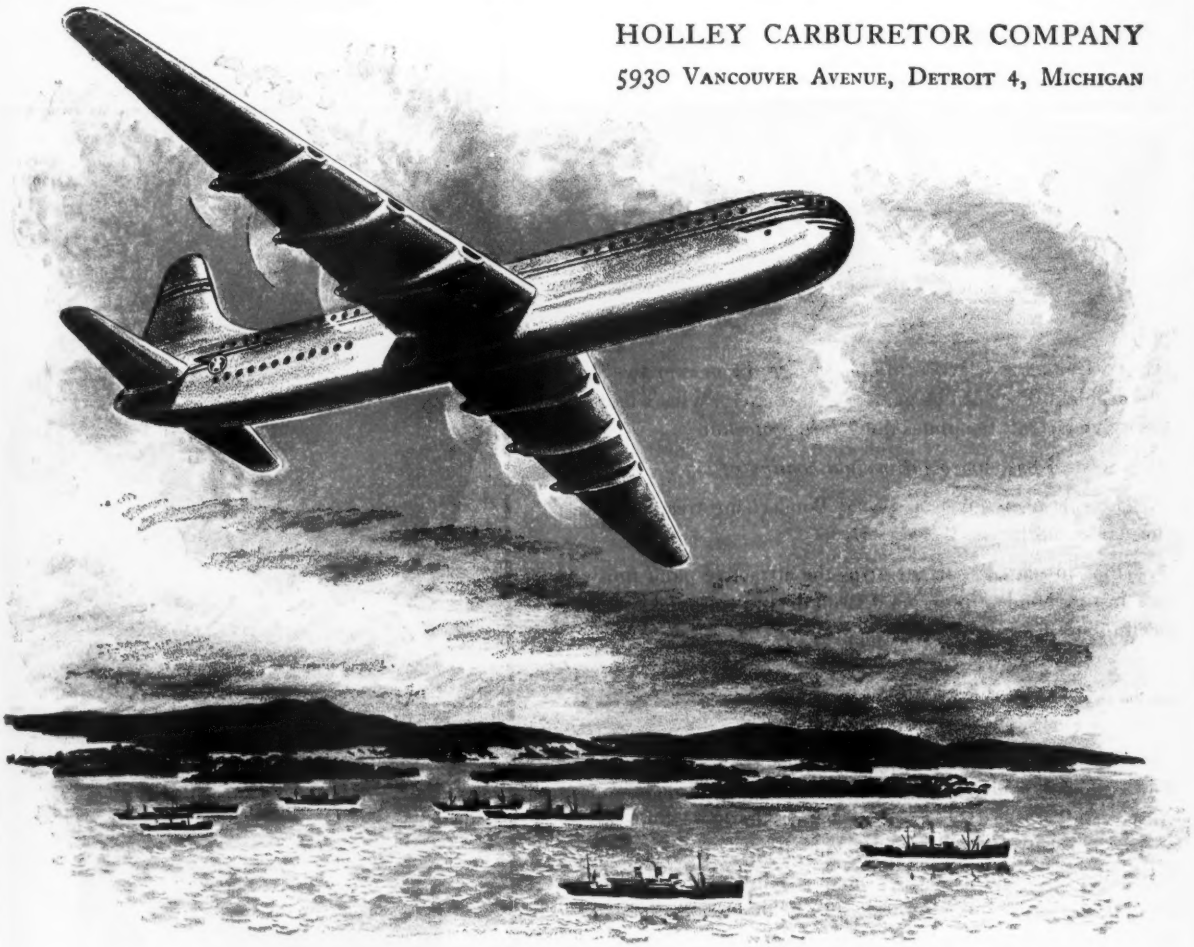

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Stability of Low-Temperature-Setting Phenol, Resorcinol, and Melamine Resin Adhesives Stored at 80°F., No. 1532.

Experiments to Develop a Rapid Durability Test for Urea-Resin Glues, No. 1533.

Effect of Moisture Content of Wood on Joint Strength in Gluing Birch Veneer and Maple Lumber with Room-Temperature-Setting and Intermediate-Temperature-Setting Phenol, Resorcinol, and Melamine Glues, No. 1534.

Instruments for Rapidly Measuring Slope of Grain in Lumber, No. 1592.

Other reports dealing with the general properties of woods and wood products, without particular reference to aeronautical applications, have been made available by the Division of Forest Pathology, Bureau of Plant Industry, in cooperation with the Forest Products Laboratory and the University of Wisconsin. In certain cases the work has been done in cooperation also with the Office of Production Research and Development of the War Production Board. The titles are as follows: *Wood Flour*, No. R565; *Preservative Treatment of Window Sash and Other Millwork*, No. R919; *Durability of Glued Laminated Barn Rafters*, No. R1232; *Treating Wood in Pentachlorophenol Solutions by the Cold-Soaking Method*, No. R1445; *Pulp Reinforced Plastics*, No. R1461; *Effect of Heat on the Properties and Serviceability of Wood: Experiments on Thin Wood Specimens*, No. R1471; *Pulps for Pulp-Reinforced Plastics*, No. R1472; *Effect of Direction of Growth Rings on the Relative Amount of Shrinkage in Width and Thickness of Lumber and Effect of Radial and Tangential Shrinkage on Dimensions of Round Timbers*, No. R1473; *Furnace-Type Lumber Dry Kiln*, No. R1474, *Supplement, Operation of an Experimental Unit*, No. R-1474-A; *Saccharification of Wood*, No. R1475; *Substitute Woods for Port Orford White-Cedar for Storage Battery Separators*, No. R1476; *Semichemical Pulp*, No. R1477; *Some Reference Books on Domestic and Foreign Woods*, No. R1479; *A Mill-Trial Comparison of Asphalt-Sized, Wet-Strengthened and Nonwet-Strengthened Cylinder Chipboard*, No. R1480; *Acid Hydrolysis of Waste Wood for Use in Plastics*, No. R1481; *Possible Use of Improved Wood and Wood-Base Plastics in the Furniture Industry*, No. R1482; *Low-Resin-Content and Resin-Free Pulp Plastics*, No. R1483; *Experiments on the Gluing of Wood Treated with Oil Solutions of Chlorophenols*, No. R1484; *Some Methods of Gluing Light Laminated or Plywood Curved Shapes from Veneer*, No. R1485; *Development of Shear Strength in Maple Block Joints Made with Two Resorcinol Glues at Temperatures from 40° to 80°F.*, No. R1486; *Possibilities of Hardwoods for Pulping*, No. R1490; *High-Yield Sulfate and Soda Semichemical Pulps from Selected Southern Hardwoods and Southern Yellow Pine for the Production of Paperboards*, No. R1491; *Wood Research Pays High Dividends*, No. R1492; *The Significance of the Discolorations in Aircraft Lumber: Noble Fir and Western Hemlock*, Forest Pathology Special Release No. 24; *Molds and Bacteria that Delaminate Plywood Bonded with Casein and Soybean Glues*, Forest Pathology Special Release No. 25. *Department of Agriculture, Forest Service, Forest Products Laboratory*, Madison, Wis.

National Advisory Committee for Aeronautics

Some Basic Laws of Isotropic Turbulent Flow. L. G. Loitsianskii. Translation of Report No. 440, of the Central-Aero-Hydrodynamical Institute, Moscow, 1939. An investigation is made of the diffusion of artificially produced turbulence behind screens or other turbulence producers. After defining the fundamental assumptions underlying the statistical turbulence theory more accurately, the writer proposes a method that permits investigation of the diffusion of turbulent disturbances of finite scale in place of the "point source" disturbances considered by Th. von Kármán. The method is based on the writer's concept of "disturbance moment" as a certain theoretically well-founded measure of turbulent disturbances. To familiarize the reader with the fundamentals of the new theory, the writer gives a presentation of the fundamentals of the theory in a form that is considered somewhat simpler than that given in existing papers. *Technical Memorandum No. 1079*, September, 1945.

Calculation of Turbulent Expansion Processes. Walter Tollmien. Translation of "Berechnung Turbulenter Ausbreitungsvorgange," reprint from *Zeitschrift fuer Angewandte Mathematik und Mechanik*, Vol. 6, 1926. On the basis of certain formulas recently established by L. Prandtl for the turbulent interchange of momentum in stationary flows, various cases of "free turbulence"—that is, of flows without boundary walls—are treated.

The report deals first with the mixing of an air stream of uniform velocity with the adjacent still air, then with the expansion or diffusion of an air jet in the surrounding air space. Experience indicates that the width of the mixing zone increases linearly with the distance from the point where the mixing starts. This fact is taken into account by the formula developed in the report.

The constant proportionality can as yet be determined only by comparison with experience; it is the only empiric constant of the theory. In many instances it will be expedient to introduce a second coordinate. *Technical Memorandum No. 1085*, September, 1945.

Effects of Range of Stress and of Special Notches on Fatigue Properties of Aluminum Alloys Suitable for Airplane Propellers. Thomas J. Dolan. Laboratory tests were made to obtain information about the load-resisting properties of X76S-T aluminum alloy when subjected to static, impact, and repeated loads. Results are presented from static-load tests of unnotched specimens in tension and in torsion and of notched specimens in tension. Charpy impact values obtained from bend tests on notched specimens and tension impact values for both notched and unnotched specimens tested at several different temperatures are included. The endurance limits obtained from repeated bending fatigue tests made on three different types of testing machine are given for unnotched polished specimens, and the endurance limits of notched specimens subjected to six different ranges of bending stress are also reported.

The results indicated that (a) polished rectangular specimens had an endurance limit about 30 per cent less than that obtained for round specimens; (b) a comparison of endurance limits obtained from tests on three different types of machine indicated that there was no apparent effect of speed of testing on the endurance limit for the range of speeds used (1,750 to 13,000 r.p.m.); (c) the fatigue strength (endurance limit) of the X76S-T alloy was greatly decreased by the presence of a notch in the specimens; (d) no complete fractures of the entire specimens occurred in notched fatigue specimens when subjected to stress cycles for which the mean stress at the notch during the cycle was a compressive stress; for this test condition a microscopic cracking occurred near the root of the notch and was used as a criterion of failure of the specimen; (e) as the mean stress at the notch was decreased from a tensile (+) stress to a compressive (−) stress, it was found that the alternating stress that could be superimposed on the mean stress in the cycle without causing failure of the specimens was increased. *Technical Note No. 852*, June, 1942.

Certain Mechanical Strength Properties of Aluminum Alloys 25S-T and X76S-T. Thomas J. Dolan. Tests have been made to determine certain mechanical strength properties of 25S-T aluminum alloy. Results are presented from static tests in tension and torsion, bending fatigue tests employing three different types of testing machines, and from impact tests of notched and unnotched specimens in tension as well as from Charpy impact tests made at several low temperatures. Information is included concerning the effects produced by repeated understressing and by anodizing, and a comparison is made of the strength properties of 25S-T alloy with data previously reported for the X76S-T alloy.

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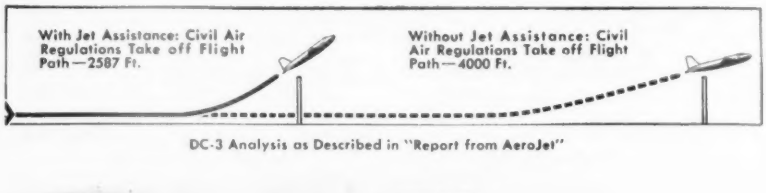
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The results indicated that: (a) The fatigue strength or maximum alternating stress that could be endured for a given number of cycles by notched specimens of these alloys decreased markedly as the mean stress in the cycle was increased in tension. (b) The fatigue strength of notched 25S-T specimens was greater than that of the X76S-T specimens when the mean stress was a tensile stress. (c) The fatigue strength of both alloys was greatly decreased by the presence of a notch in the specimens. (d) A large number of cycles of understress produced no great or consistent change in the final fatigue strength of these two alloys. (e) Anodizing produced a slight increase in fatigue strength of the X76S-T alloy but did not affect the endurance limit of the 25S-T alloy. *Technical Note No. 914*, October, 1943.

Development of a Detonation Detector Suitable for Use in Flight. C. S. Draper, E. S. Taylor, J. H. Lancor, and R. T. Coffey. Apparatus for making quantitative measurements of the vibrations excited by detonation in the cylinder head of an aircraft engine was designed and constructed. The apparatus consisted of pickup units designed to operate under engine conditions and to produce an electrical output proportional to the velocity of a small diaphragm; an amplifying system with uniform sensitivity from 5 to 40,000 cycles per sec.; and a cathode-ray oscillograph with a high-speed camera recording system.

A large number of records were taken under various operating conditions in a single-cylinder aircraft engine. The final detonation detector was tested in two full-scale multicylinder engines. The instrument checked well with visual observations of the exhaust and could detect the occurrence of moderate knock as distinguished from the vibration caused by valve seating. *Technical Note No. 977*, December, 1944.

Nondestructive Measurement of Residual and Enforced Stresses by Means of X-Ray Diffraction: Part I—Correlated Abstract of the Literature. George Sachs, Charles S. Smith, Jack D. Lubahn, Gordon E. Davis, and Lynn J. Ebert. From a study of the published matter on this subject, it appears that stress measurements by means of the X-ray diffraction method have found considerable application in the solution of both commercial and laboratory problems. However, an experimental and theoretic investigation of numerous factors that influence the practical execution of the X-ray method shows that the conditions in commercial structures are not conducive to accurate stress determinations.

The X-ray diffraction method revealed some fundamentally important facts regarding (a) the stress distribution in structures containing sudden section changes and subjected to elastic or plastic straining, and (b) the stress distribution within the bead of a weldment. However, the X-ray method does not appear sufficiently developed, at the present, to meet the requirements of a practical method of stress measurement, such as the following: (a) The experimental technique should be simple. (b) Any metal in a commercial condition should be subject to the method. (c) The calculations should be readily performable by means of graphs, tables, or graphic methods. (d) The results should be accurate and clearly explainable.

Thus the stress determinations by means of X-ray diffraction must be limited in the near future to research and development work, which allow a choice of the optimum metal conditions and exposure conditions for such work. Two selected problems that were investigated in detail will be discussed in a forthcoming report. *Technical Note No. 986*, September, 1945.

Survey of Adhesives and Adhesion. R. C. Rinker and G. M. Kline. A research project has been undertaken at the National Bureau of Standards under the sponsorship of the N.A.C.A. to obtain information about the strengths of bonds between different chemical types of adhesives and adherends. The present report, which incorporates a survey of the present knowledge on the nature of adhesion, has been prepared as the initial step in this investigation.

The scope of the survey includes the theoretic aspects of adhesion and properties of adhesively bonded structures, under which the study is subdivided into the following groups: (1) intermolecular and interatomic forces; (2) the nature of cohesion and of adhesion; (3) physical strength of bonds; and (4) test method for bond structures. An extensive bibliography contains references to books, technical publications, patents, and reports of aircraft manufacturers, adhesive manufacturers, and Government departments in the United States and Great Britain. *Technical Note No. 989*, August, 1945.

Properties of Some Expanded Plastics and Other Low-Density Materials. Benjamin M. Axilrod and Evelyn Koening. Various mechanical and physical properties of several expanded plastics and other low-density materials of interest for aircraft applications, such as heat insulation or the core of a sandwich material, were investigated. The materials included in the program were cellulose acetate plastic, polystyrene, a urea-formaldehyde resin, a zein product, hard rubber, balsa wood, and cellular glass. The properties studied included density, thermal conductivity, dimensional stability on exposure to extremes of temperature and relative humidity, resistance of the materials to chemicals, and flexural and compressive strengths and moduli of elasticity.

The density of the polystyrene expanded material was one-fourth, urea-formaldehyde one-half, and hard rubber and cellulose acetate about the same as that of the low-density balsa, 0.08 Gm. per cu.cm. The other materials had greater densities than balsa.

The hard rubber had the lowest thermal conductivity of the materials tested and compared favorably with commercial insulating materials.

The glass and polystyrene expanded materials exhibited the smallest change in weight and in dimensions on exposure to extremes of temperature and relative humidity. Only the glass material remained unaffected after 7 months' outdoor exposure. The least dimensional and percentage weight changes on immersion in various chemicals and after drying were exhibited by the glass product and hard rubber, in that order.

Balsa was greatly superior to the other materials in modulus of rupture in bending and in flexural modulus of elasticity. The hard rubber had the highest modulus of rupture and flexural modulus of elasticity of the expanded organic materials. On a stiffness-weight basis, the flexural properties of the polystyrene approached those for the balsa. Balsa was much superior to the other materials in compressive properties. *Technical Note No. 991*, September, 1945.

Industry Heads to Advise Agency on Research Needs. In order to assure full cognizance of the nation's overall aeronautical research requirements, the N.A.C.A. has established an Industry Consulting Committee composed of eight heads of aeronautical manufacturing and operating companies, who will advise the N.A.C.A. as to general research policy and programs, especially with regard to the needs of industry.

Members of the Industry Consulting Committee include Lawrence D. Bell, President of Bell Aircraft Corporation; Jack Frye, President of Transcontinental & Western Air, Inc.; Robert E. Gross, President and Chairman of the Board of the Lockheed Aircraft Corporation; H. M. Horner, President of United Aircraft Corporation; Beverly Howard, President of Hawthorne School of Aeronautics; J. H. Kindelberger, President and General Manager of North American Aviation, Inc.; C. Bedell Monro, President of Pennsylvania-Central Airlines Corporation; William T. Piper, President of Piper Aircraft Company.

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Sur Quelques Problèmes de la Théory Tourbillonnaire de l'Hélice Propulsive et de l'Aile d'Avion (On Some Problems of the Vortex Theory of Airplane Propellers and Wings). N. Florine. This report presents new methods for the solution of certain problems pertaining to airplane propellers and wings. It is stated that the application of these methods seems to be justified in view of the manner in which the results agree when the same cases are treated by conventional methods.

Sections of the report pertain to induced velocities on propeller blades; distribution of circulation, creating forced induced velocities; optimum distribution of circulation; calculation of operation conditions of a given propeller; the airplane wing, a limited case of the propeller blade; a wing that has a plane of symmetry and is twisted symmetrically and antisymmetrically; abrupt variations of the depth of the wing. Six appendixes, pertaining to formulas, functions, and numerical integration are included. *Bulletin du Service Technique de L' Aeronautique*, Rhode Saint-Genese, Belgium, July, 1944.

British Information Services

Radar. An official history of the science of radar is given in a pamphlet of 30 pages. It contains technical descriptions of the principles of the science and of the apparatus used. The origin of the method is traced from the period shortly after the first World War, when radio waves and echoes were used to determine the height of the Heaviside layer in the atmosphere above the earth. A series of brief items reviews the progress made in the development of the technique and the application of the apparatus to warfare on land, on sea, and in the air. The contributions of numerous British industries are noted, as well as the assistance rendered by the United States and Canada.

One section gives a description of how radar works, using nontechnical language and without reference to mathematics. The use of radar by the Royal Air Force and by the British Army and Navy is described. A glossary defines terms and abbreviations applied to radar work.

Propeller-Blade Vibration Forced by Engine Torque Variations: Dynamic Effects of Applying Pendular Masses to the Propeller Hub. B. C. Carter. With the object of reducing propeller-blade vibration associated with torsional vibration in the crankshaft system, a propeller-manufacturing firm has made some tests of the efficacy of applying pendular masses to propeller hubs with the masses arranged to oscillate in the plane of rotation. A mathematical analysis of the functioning and effects of such masses was required. Forced vibration of a relevant flywheel system is examined analytically for pendular masses tuned in various relationships to the forcing frequency. The mathematical argument is set out and some inferences from the derived equations are given.

The main inference is that, while pendular masses attached to the hub may reduce the amplitudes of blade-stress oscillation for the order of vibration for which they are tuned, the masses have a heavier duty to perform than they would have if attached to the crankshaft; they have, in fact, to offset the forcing torque amplified by forced vibration of the crankmasses about a node at the hub. The amount of pendulum inertia that should be provided requires consideration in relation to the magnitude of excitation, the crankmass inertia, and the damping in the engine.

Where circumstances permit, it is better to apply pendular masses to the crankshaft rather than to the hub. Mounting the masses on the hub may make conditions more severe for the engine by reducing or eliminating the damping effects of propeller vibration. *Ministry of Aircraft Production, Aeronautical Research Committee, R. & M. No. 1935;* British Information Services, New York, $0.45.

Arctic War. Now that the European War is over, the records of individual areas where action occurred are being written. Northern Norway was an important section, and the defense by Norwegian and British soldiers and airmen makes a unique story of a fight against cold, as well as against the Germans.

The various sections of the booklet give information about the importance of the Arctic regions and the specialized operations required to meet climatic conditions and in conducting warfare there, including the work of the polar weather stations, the Commandos, the naval forces, and the ski troops. A section titled "Wings over the Arctic" describes the services rendered by the air forces and their equipment. *British Information Services*, New York, $0.30.

Measurements of Rudder Hinge Moments on a Model of a Single-Engined Aircraft. L. W. Bryant, A. S. Halliday, and C. H. Burge. Investigations to determine the incidence of "snaking" of aircraft and rudder-fuselage flutter are reported on the basis of wind-tunnel experiments with models. One model had a full body and "stub" wings, built to a scale of 1:7; the other had a full body only, built to a scale of 1:3.5. The experiments were carried out to ascertain the rudder hinge moments with various modifications of the rudder, in an attempt to explain full-scale experience. The rudder hinge moments were measured over a range of rudder settings and angles of yaw of the model, at a wind speed of 60 ft. per sec. Most of the tests were made in the 7-ft. wind tunnel. A few tests were made in the open jet on the stub-wing model, with a propeller running in position in front of the fuselage. Results are given in extensive tables and graphs and are explained in the text with respect to hinge moments of original rudder without trailing edge strips; the effect on hinge moments of trailing-edge strips; stub-wing and stub-body models compared; the effect of slipstream on rudder hinge moments; and the effect of sag of fabric. *Ministry of Aircraft Production, Aeronautical Research Committee R. & M. No. 1939;* British Information Services, New York, $1.05.

Calculation of Additional Mass and Inertia Coefficients for Rectangular Plates in Still Air. W. Prichard Jones. The additional mass and inertia coefficients for rectangular plates of various aspect ratios have been determined experimentally by Scruton and by Gracey. For comparison with their results, some theoretic values are calculated in the present paper by the use of an approximate form of the doublet distribution method, which is explained. In this method, the oscillating plate is assumed to be infinitely thin and is replaced by an equivalent sheet of doublets which induces the same irrotational field of flow in the surrounding air. The appropriate distribution of doublets is such that the normal induced velocity is equal to the normal velocity of the plate at all points. Formulas are derived for the induced velocities corresponding to certain modes of doublet distribution and the required combination of modes can be obtained by satisfying the normal velocity conditions at a number of points on the plate. In view of the large number of simultaneous equations which would have to be solved in this treatment, an approximate method is substituted in which the chordwise distribution of velocity due to any chordwise mode of doublet distribution is assumed to be proportional to the chordwise velocity distribution as derived by two-dimensional theory. This assumption simplifies the numerical work, as it is then sufficient and most convenient to satisfy the velocity condition along the midchord axis only. The required doublet distribution is then readily found by collocation for any mode of motion.

The approximate method is applied to determine the additional moments of inertia of rectangular plates of aspect ratios 4 and 6 with linear modes of displacement in flexure and torsion. Additional mass coefficients for translational motion of the plates in the normal direction are also calculated. The values obtained, expressed in nondimensional form, are plotted against aspect ratio for comparison with the experimental results. They are in fair agreement with some of the experimental results but are, however, lower than the mean experimental values. This may be due to the neglect of viscosity effects in the analysis, and to the assumption that the amplitudes of the motion are small. Also, near the tip, the chordwise distribution of velocity is only roughly proportional to the two-dimensional distribution. A sim-

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ilar method could be used to determine the additional mass inertia coefficients for tapered wings. *Ministry of Aircraft Production, Aeronautical Research Committee, R. & M. No. 1947;* British Information Services, New York, $0.45.

The Measurement of Tailplane Stiffness. J. Taylor. In view of the possible necessity for a stiffness requirement for tail planes and to assist research work on tail-plane flutter, static tests have been made of a number of tail planes to provide typical stiffness data. As the section to which the requirements would apply has still to be defined, tests were made at two sections suitably positioned to allow of estimation of the stiffness over a considerable span of the tail plane. A method has been evolved from the tests which should be satisfactory for routine use on all types of construction current in tail-plane design. *Ministry of Aircraft Production, Aeronautical Research Committee, R. & M. No. 1951;* British Information Services, New York, $0.45.

Theoretical Determination of the Aerodynamic Inertias of an Elliptic Plate in Still Air. W. Prichard Jones. Formulas are derived for the aerodynamic inertias of an elliptic plate, to take the place of information contained in a Russian report of the work of V. S. Vedrov which was found to be obtainable outside of Russia. The already known expression for the aerodynamic mass of an elliptic plate is given for completeness, and the numerical values of the nondimensional inertia coefficients, which are defined, are tabulated and plotted against the generalized aspect ratio. Some theoretic and experimental results for rectangular plates are included in the diagrams for comparison. *Ministry of Aircraft Production, Aeronautical Research Committee, R. & M. No. 1953;* British Information Services, New York, $0.40.

Republic of Uruguay

Reglamentacion del Codigo de Legislacion Aeronautica (Regulation of the Code of Air Legislation). The several changes made in the air laws of Uruguay by a Government decree of June 9, 1944, are given in this publication. *Office of the Minister of National Defense.*

British Air Ministry Translations*

The list below supplements those published in previous issues of the AERONAUTICAL ENGINEERING REVIEW.

Aeronautical companies and other organizations may borrow copies of these translations through the facilities of The Paul Kollsman Library upon application by the company librarian. Because of the importance of this material, the regular library loan period has been extended to two weeks, in order that these translations may be utilized to their full advantage. Requests should be made by number, author, and title on regular Library book request cards. Because of the many requests for these translations, no more than five copies may be borrowed at one time by one organization.

The translations have been reproduced from typewritten copy, and the number of pages in each is indicated at the end of each reference. Bibliographic information has been taken directly from the translations. Photostatic copies are also available at the usual library rates.

2524 Marsch, O. *Construction and operation of climatic testing chambers for communication equipment.* Elektrotechnische zeitschrift, v. 64, no. 37–38, p. 507–510. 8 p. The construction and operation of installations for testing communication equipment under various simulated climatic conditions are described.

2525 Peres. *The role of rheological analogies in certain aerodynamical problems.* Extract of lecture to be read by Prof. Peres. 2 p. The principle that the electrical potential generated in a conductor is a harmonic function, and that a rheological counterpart exists for problems relating to harmonic potentials, is discussed briefly in relation to its applications to aerodynamics. A wing computer and a propeller computer are included in the discussion.

2526 Tanzler, H. U. *Rotary displacement type compressors for scavenging small two-stroke engines.* Automobiltechnische zeitschrift, v. 46, no. 2, January 25, 1943, p. 31–36. 9 p. A rotary compressor whose casing also rotates is shown to provide leak-free compression with very small friction losses, but is difficult to install in a two-stroke engine. A new type is described, in which only the rotor rotates. The centrifugal forces on the vanes, mounted to oscillate as pendulums, are absorbed by two lateral rotating discs. The performance and efficiency of the new type were satisfactory in tests with an experimental model.

2528 Samtleben, A. *The utilization of the ammonia and hydrogen sulphide, from coke oven gas.* Communication from the Laboratory of the German Gas Works. 6 p. Laboratory tests on the utilization possibilities of the ammonia-soda process for recovering sodium bicarbonate by washing raw gas in a common salt solution, resulted in a 70 per cent utilization of the salt. Ammonium sulphate was produced direct from raw gas containing ammonia and hydrogen sulphide by using a 45 per cent hydrogen peroxide solution, utilizing 82.5 per cent of the hydrogen peroxide. The ammonia contained in the raw gas could be completely converted into ammonium sulphate by washing the gas with a thin paste of gypsum and water.

2529 Meinke, H. *Coaxial line elements which produce no disturbing fields at high frequencies.* Hochfrequenztechnik und elektroakustik, v. 61, no. 5, May, 1943, p. 145–151. An experimental procedure and analysis of symmetrical quadripoles is presented, in relation to insulated supports in coaxial lines, increases in cross section, cone-shaped conductors, and angle bends in transmission lines. Suggestions for the extension of the methods used are made.

2530 Messerschmidt a.-g. *Me 262. Possible purposes of employment.* Supplement to description of the aircraft dated August 10, 1943, pp. 23106–23213. 92 p. Abridged descriptions are given, with performance curves, of 10 variants of the Messerschmitt 262A fighter airplane, to show the diversity of the possibilities of its military use with the minimum amount of modification. The data are supplied by the manufacturer.

2531 Staudinger, H. *High polymer compounds, the relationship between the length of chain molecules and the specific viscosity of their solutions.* Deutsche chemische gesellschaft, Berichte, v. 65, 1932, p. 267–279. 9 p. Comparisons were made of paraffins, polypyrenes, hydrocaoutchouc, poly-isobutylenes, polystyrols, and poly-indenes, having different molecular weights for the same chain length. The constants of chain-equivalent hydrocarbons vary somewhat. Chains of equal length in different hydrocarbons of equal concentration have only approximately the same specific viscosity. The relationships established between viscosity and chain length are to be explained only by regarding the fiber molecule as a rigid elastic structure.

2532 Tamm, R., and Bath, F. *Measurements with the copper oxide rectifier.* Veröffentlichen auf dem gebiete der nachrichtentechnik, v. 6, no. 1, 1936, p. 51–68. 22 p. Electrical measurements by means of the copper oxide rectifier are discussed in terms of mechanical design, electrical properties, alternating current characteristic, types of rectification, temperature compensation, frequency rate and its correction, remote controlled rectifiers, and modulators.

2533 Göttingen. Aerodynamische versuchsanstalt. *Report of temperature measurements on the wing of a He 177 with hot air deicing system.* Prague. Branch station, Institute for low temperature research, 1941. 16 p. Detailed measurements were made over the length and depth of the outer wing of a Heinkel 177 four-engined bomber airplane fitted with a hot air deicing system, under different conditions of flight, to determine the efficiency of the deicing system. The results are presented in tables and charts, and are briefly discussed with recommendations for the improvement of the deicing system.

2534 Kirner, J. *On some interesting observations on the case-hardening of steel, particularly with regard to the effect of nitrogen.* Z. F. ges. hütten/metallurgie, 1911, no. 3, p. 72–77. 8 p. Tests were conducted on case-hardening substances, one of which contained 41 per cent sodium chloride, 9 per cent total nitrogen

* Selected translations are available in reprinted form (on 8½ by 11 paper) from the Durand Reprinting Committee, c/o Aeronautics Department, California Institute of Technology, Pasadena 4, Calif., at $0.05 per page. The translations are also available on a yearly subscription basis at $0.05 per page with a guarantee that not over 2,000 pages per year will be reprinted. As the cost of reprints varies as a function of the number of subscribers, this service will be available at $0.03 per page upon receipt of 23 more subscribers.

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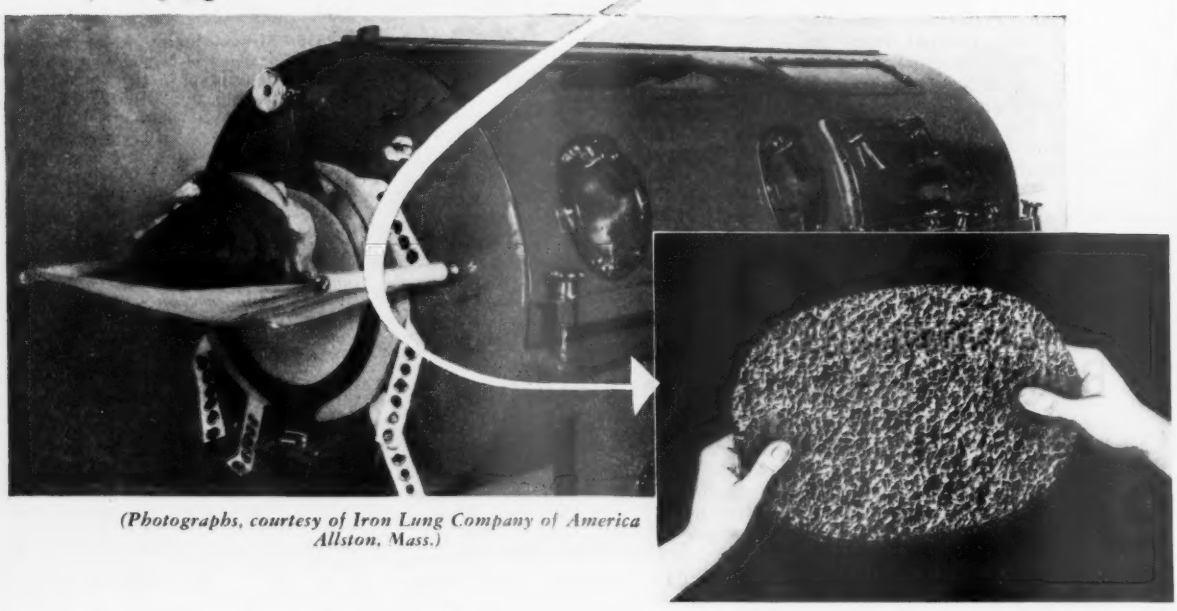

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2535 Wunderlich, R. *Covering the working methods of a cathode follower amplifier.* Elektrische nachrichten-technik, v. 19, 1942, p. 63, ff. 4 p. When it is desirable in an amplifier that the output voltage be isolated from the anode voltage, the cathode follower connection may be advantageously employed. The mode of operation of such an amplifier is analyzed. Input and output voltages are in phase, in contrast to the normal amplifier circuit. The amplifier can be used only as a power amplifier, not as a voltage amplifier. Measured and calculated characteristics are presented.

2536 Wirtschaftsgruppe luftfahrt-industrie. *Specification for steel castings.* (Report 1.) 4 p. Specifications and test procedures for aircraft steel castings are outlined.

2537 Hansen, W. H. *Brazing under a protective gas atmosphere in the electric resistance furnace.* Metallwirtschaft, v. 21, no. 11–12, 1942, p. 158–162. 8 p. With the development of the electric furnace, it became possible to carry out the brazing process in a protective atmosphere on a large scale. Fundamental principles, formation of the brazed joint, brazing temperatures and durations, mechanical conditions, protective gases and their production, and the design of brazing furnaces are discussed.

2538 Germany. Reichsluftfahrtministerium. *Testing programme for airborne weapons.* Reports 1–4. 10 p. The procedure for testing automatic air-borne weapons up to 30-mm. cal. is outlined, as practiced by the Test Center of the German Air Ministry. Procedures for the testing of mountings and accessories for air-borne weapons, ring mountings, and electrical, pneumatic, and hydraulic equipment are also given.

2539 Schulze, W. M. H. *The influence of climate on material stressing under tropical conditions.* Zeitschrift für fernmeldetechnik, werk- und gerätebau, v. 27, no. 1–3, January 15, 1943, p. 1–10, 21–28, 35–40, 40 p. The characteristics of tropical climates are reviewed and their effect on the selection and use of engineering materials is compared with the effect of temperate climates. It is concluded that there are few specific demands imposed upon materials by tropical climates, though combinations of specific conditions may arise which require careful selection of materials. Temperature fluctuations encountered in flying are greater than those found in the tropics. The higher humidity in the tropics is important, especially for insulation and dielectric materials used in communication engineering, which should be dampproof. The higher ultraviolet content of light and greater intensity of solar and astral radiation are characteristic of tropical climates and of temperate zones at high altitude, and organic materials, such as paint and varnish, require about the same precautions for both types of climate. The action of termites and other biological pests is greater in the tropics and requires more attention.

2540 Findeisen, W. *Do condensation nuclei originate at the surface of the sea?* Meteorologische zeitschrift, October, 1937, p. 377–379. 4 p. It is shown that the majority of condensation nuclei, which are necessary for the formation of water vapor clouds, originate on the continents and are not salt particles originating at the surface of the sea. No appreciable number of condensation nuclei are formed at the surface of the sea, but an average of a few thousand per cm.^{3} are found in pure country air and several hundred thousand in the neighborhood of industrial installations.

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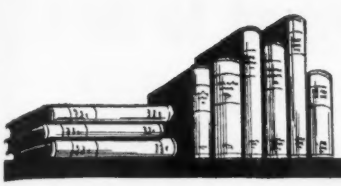

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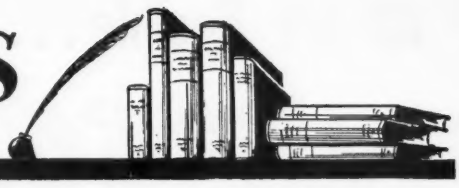

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Atomic Energy for Military Purposes

Henry DeWolf Smyth

Contents: Statement of the Problem; Administrative History Up to December 1941; Progress Up to December 1941; Administrative History 1942–1945; The Metallurgical Project at Chicago in 1942; The Plutonium Production Problem as of February 1943; The Plutonium Problem, January 1943 to June 1945; General Discussion of the Separation of Isotopes; The Separation of the Uranium Isotopes by Gaseous Diffusion; Electromagnetic Separation of Uranium Isotopes; The Work on the Atomic Bomb; General Summary.

The official report of the development of the atomic bomb states the theory of atomic energy and gives the history of the developments that led to the practical application of fission chain reaction to the production of materials for the bomb and to the method by which it operates. The history of the atomic bomb project is given in as much detail as present security restrictions permit.

The first part of the book contains a brief survey of the advances in nuclear physics between 1896 and 1940, outlining the fundamental principles upon which the work was based. Succeeding chapters recount the administrative and production progress made in the building of plants, the procurement of materials, and the manufacture of the bombs. Appendixes refer to (1) Methods of Observing Fast Particles from Nuclear Reactions; (2) The Units of Mass, Charge, and Energy; (3) Delayed Neutrons from Uranium Fission; (4) The First Self-Sustaining Chain-Reacting Pile. Appendix 5 gives a sample list of reports prepared in the Metallurgical Laboratory of the University of Chicago, and the sixth appendix contains the text of the War Department release concerning the test of the atomic bomb in New Mexico. There is an index of persons mentioned in the report and an index of the principal subjects treated.

The report was written at the request of Major Gen. L. R. Groves of the U. S. Army, who was in charge of the Atomic Bomb Project. Princeton University Press, Princeton, N.J., 1945; 264 pages, $1.25.

Book Notes

Air-Age Geography and Society, by James Franklin Chamberlain, revised edition by Harold E. Stewart; J. B. Lippincott Company, Philadelphia, 1945; 717 pages, $2.12.

The influence of the airplane on the study of the science of the earth and its life is recognized in the revised edition of this geography. The text is divided into three sections, physical, commercial, and political geography. It is well illustrated and up to date.

Americans Valiant and Glorious, by William D. Pawley; Grand Central Art Galleries, New York, 1945; 76 pages.

William D. Pawley in an illustrated booklet records the origin and organization of General Chennault's Flying Tigers. Since Mr. Pawley was instrumental in bringing the group together, his account provides first-hand information as to how it was formed. He pays individual tribute to those who assisted him in this work.

Raymond P. R. Neilson has painted portraits of many of the Flying Tigers. Twenty-eight of those portraits are reproduced in this book, together with a short biographic sketch of each pilot. A roster of the American Volunteer Group is included.

Atomic Bombs, by Frank and Doris Hursley; Syracuse University Press, Syracuse, N.Y., 1945; 67 pages, $1.00.

A description and story of the atomic bomb as presented in a radio program. The style of the presentation takes the form of a script read by a narrator and actors portraying the roles of some of the many persons who had parts in the production and use of this new war weapon.

My Favorite War Story, compiled by the Editors of *Look* magazine; Whittlesey House, McGraw-Hill Book Company, Inc., New York, 1945; 155 pages, $2.50.

Compiled from the pages of *Look* magazine, these 34 dramatic tales record some of the thrilling instances of gallantry, intrigue, violence, and espionage of the war. Each story is related by a different war correspondent, whose career is briefly reviewed.

Several of the stories are about war in the air. Ernie Pyle's "30-to-1 on Death" is one of the best stories.

500 Postwar Jobs for Men, by the Vocational Guidance Research; Doubleday, Doran and Company, Inc., Garden City, N.Y., 1945; 285 pages, $2.50.

A compilation of vocational opportunities gives an alphabetical listing of 500 different kinds of work, in business, the professions, industry, agriculture, civil service, research, and management. The present outlook for such jobs, a description of the job, its requirements, advantages and disadvantages, and the range of salaries are given. A cross-reference index is included.

Among the jobs listed are those of air-cargo representative, air-line pilot, air-line engineer, air-line meteorologist, air-line publicity representative, air-line radio operator, aircraft-accessories salesman, aircraft salesman, airport engineer, airport manager, and aviation-insurance adjuster.

Bridging the Atlantic, compiled by N. C. Baldwin; Francis J. Field, Ltd., Sutton Coldfield, England, 1945; 95 pages, 10*s.* 6*d.*

The latest addition to the series of handbooks on the history of air-mail flights covers the field of Atlantic flights. Over 350 flights attempted and made in the period from 1873 to 1944 are summarized, and a description is given of the air-mail covers carried.

Many illustrations are shown and some idea of the prices asked for the covers is given. As a record of transatlantic flights the book is a valuable addition to the chronology of ocean flying.

Aluminum Applications by Industries; Aluminum Company of America, Pittsburgh, 1945; 73 pages.

Lists in tabular form state the uses for which aluminum is a suitable material. The information is classified by industries and subdivided into specific applications. One section is concerned with the extensive uses for the metal in the aircraft industry and detailed lists of aircraft parts and assemblies are given.

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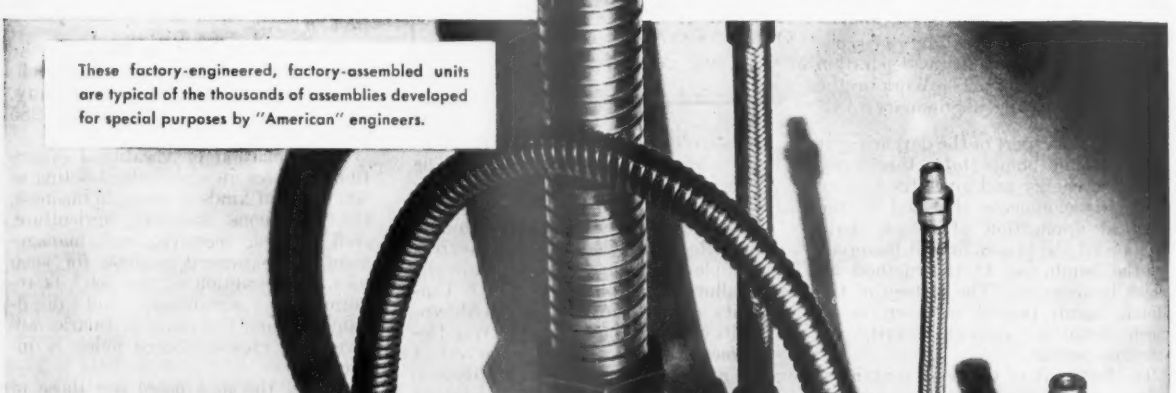

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Radio Operators' Code Manual with Touch Typing, by Wayne Miller; Ziff-Davis Publishing Company, Chicago, 1943; 144 pages, $2.00.

Instructions for sending and receiving international Morse code are supplied in this manual for radio operators. The course of study entails committing the character sounds to memory and converting them to the bodily action of key manipulation in the case of transmission, and writing or typing in the case of reception.

Detail Aircraft Structural Analysis, by Harry M. Turner, Herman Pusin, Julius E. Pauken, Walter B. Kennedy, Jr., Robert M. McFarlane, George E. Holback, Richard K. Wentz, George E. Smith, Paul A. Piper, edited by G. N. Mangurian, N. M. Johnston, Jr.; The Glenn L. Martin Company, Baltimore, 1945.

Basic structural principles are set forth in a series of eleven pamphlets comprising a course for aircraft designers. The information contained in these pamphlets is intended for use in solving everyday structural-design problems rather than uncommon problems that involve more complicated structural principles. Pamphlets Nos. 1 through 5 explain the basic structural principles necessary in the analysis and design of structural details. The structural analysis and design of aircraft details that the designer encounters almost every day are described in pamphlets Nos. 6 through 10.

Each pamphlet contains examples worked out to illustrate the text. At the end of each pamphlet, problems are given which should be solved by the reader in order to prove to himself that he understands the subject covered.

Machine Tool Guide, by Tom C. Plumridge in collaboration with Roy W. Boyd, Jr., and James McKinney, Jr.; American Technical Society, Chicago, 1945; 761 pages, $7.50.

Prepared especially for tool engineers, this reference book contains information about a large number of machine tools. The information is assembled in organized form and includes detailed specifications and drawings of machine tools and their various parts.

Electromagnetic Engineering, by Ronold W. P. King; McGraw-Hill Book Company, Inc., New York, 1945; 580 pages, $6.00.

Volume I of a series of advanced textbooks on electromagnetic engineering is designed to follow closely, although in somewhat expanded form, the subject matter presented in courses in electronics, communication engineering, and applied physics at the Cruft Memorial Laboratory, Harvard University. The book has been written to provide the physical and mathematical background prerequisite to the systematic study of such fields as antennas and wave propagation, transmission circuits, and transit-time electronics.

The Technology of Plastics and Resins, by J. Philip Mason and Joseph F. Manning; D. Van Nostrand Company, Inc., New York, 1945; 493 pages, $6.50.

Developed to be suitable for students who have had introductory courses in general and organic chemistry, this book is intended to serve as an introduction to both the chemistry and the practical utilization of plastics and resins. The material should also be useful to men in industry who wish to refresh their knowledge of the fundamentals underlying plastics development and technique. The book is divided into three sections, the first of which deals with theoretic and general aspects of the subject; the second with methods of preparation and the properties of resins and plastics; and the third with fabrication techniques.

Plastics, by J. H. DuBois; American Technical Society, Chicago, 1945; 447 pages, $4.00.

The third edition of a volume on plastics written to serve as a textbook for schools and to aid users of plastics who require basic information about these materials. The important plastic materials and products are described and the properties of plastics are listed in tables.

Higher Surveying, by Arthur Lovat Higgins; Macmillan and Company, Ltd., London, 1944; 463 pages, $5.00.

A book designed to meet the requirements in surveying and geodesy of the engineering-degree courses in universities. The author's aim is to impart that information without digressing too far from the field aspects of the subject. Special sections are devoted to aerial surveying and air photographs.

A Bibliography on Cutting of Metals, prepared by Orlan W. Boston; The American Society of Mechanical Engineers, New York, 1945; 547 pages, $6.50.

An extensive reference list of articles on the subject of metal cutting. Brief abstracts of the articles are included.

Guide to Weldability of Steels; American Welding Society, New York, 1945; 89 pages, $1.00.

A description is given of a proposed system of determining the effect of welding procedure on the ductility of the heated zone adjacent to the weld zone in plain carbon and alloy steels. The object of the method is to preserve ductility in weldments in the constructional steels.

Technical Data on Plastics; Plastics Materials Manufacturers' Association, Washington, D.C., 1945; 163 pages, $1.50.

The purpose of this book is to acquaint users of plastic materials with the nature, particular merits, and utility of various plastics and with their properties and values, as measured by recognized methods. The methods are those commonly to be expected in available forms and modifications of the various basic compositions. Brief explanatory forewords are followed by tables and charts of more detailed data.

A.S.T.M. Standards on Plastics; American Society for Testing Materials, Philadelphia, 1945; 542 pages, $2.75.

Approximately 109 test methods, standards, specifications, recommended practices, and definitions applicable to a wide range of plastics are contained in this compilation, which is dated May 5, 1945. There are 23 specifications giving quality requirements for different kinds and families of plastics. Other standards listed include 24 relating to electric insulating materials, and 24 to plastic testing.

Principles of Physics, III, by Francis Weston Sears; Addison-Wesley Press, Inc., Cambridge, Mass., 1945; 323 pages, $4.00.

Volume III of a series of books on the principles of physics, used in the first and second years of the course at the Massachusetts Institute of Technology, is devoted to optics. Emphasis is placed on theoretic aspects of the subject, the historical background and practical applications being given a place of secondary importance. The first nine chapters are concerned chiefly with the propagation of light. Remaining chapters deal with line spectra, thermal radiation, photometry, and color. A section of the chapter on polarization is given to optical stress analysis. Included in the chapter on line spectra are sections outlining the Bohor theory of atomic structures and giving some of the main lines of thought and experimental evidence leading to the theory of wave or quantum mechanics. Various scientific instruments used in aeronautical research are explained.

An Analysis of the Motion of a Rigid Body, by Edward W. Suppiger; The University of Illinois, Urbana, Ill., June, 1945; 60 pages, $0.75.

In this Bulletin Series No. 353 of the Engineering Experiment Station, the author develops an analysis of the motion of a rigid body from an engineering point of view, with concepts familiar to the engineer. General equations of motion are obtained in terms of force, mass, and acceleration; and in terms of kinetic energy. It is stated that textbooks on engineering mechanics sometimes fail to indicate the relationship and continuity that exist between certain types of motion, especially between two- and three-dimensional types. In Chapter II various special cases are obtained from the general equations by applying the proper limiting conditions. Eight examples are solved in order to show the application of the equations in this chapter. All of these examples can be solved by means of the energy equations in Chapter III but only two illustrations are given in order to demonstrate the method.

The general equations of dynamics are useful in the mechanical, electrical, and aeronautical fields. The development of the subject matter is based on Newton's equations of motion for a particle; extensions to systems of particles are based on the works of Euler and Lagrange.

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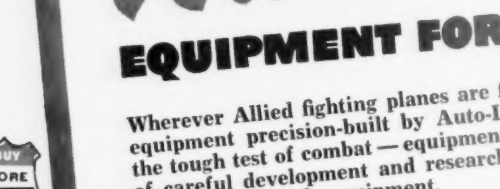

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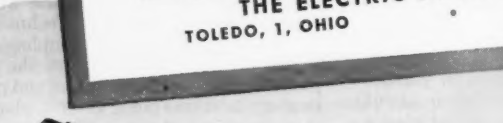

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Civil Air Regulations for Pilot Certification; Aero Publishers, Los Angeles, 1945; 115 pages, $1.50.

A compilation of the Civil Air Regulations pertaining to the certification of pilots is offered for the convenience of those preparing to take C.A.A. examinations. It contains the information about the Civil Air Regulations required to pass that part of the written examination for the commercial pilot rating, as explained in Part 20, sections 20.56 through 20.561.

The first section contains a guide for the written examination. The second section comprises reprints of those parts of the regulations applicable to pilots. Section Three includes general check questions on the regulations for pilots, and Section Four contains all recent amendments of the regulations up to the date of publication of the manual. The fifth section is an appendix containing miscellaneous information and a reproduction of Safety Bulletin No. 166.45 titled "Why Do Pilots Have Mid-Air Collisions and How They Can Be Avoided," by Roscoe B. Bancroft, of the Civil Aeronautics Administration. The manual is intended particularly for military pilots who are preparing for commercial aviation work.

A War Job "Thought Impossible," by Wesley W. Stout; Chrysler Corporation, Detroit, 1945; 51 pages.

The Chrysler Corporation made 5,500 Sperry gyrocompasses for the Navy as a part of the war effort. This pocket-sized book tells the story of that achievement. It is well illustrated and shows how specialists in one industry can undertake to make the most delicate products of another field.

Soundings in the Literature of Management, by Harry Arthur Hopf; Hopf Institute of Management, Inc., Ossining, N.Y., 1945; 26 pages, $0.75.

A bibliography of fifty selected books setting forth the basic principles of the art and science of management. The list includes 14 able works on scientific management, 12 books regarded as indispensable in the field of management, and 24 books which, taken as a whole, should provide an adequate foundation for the acquisition of a thorough knowledge of the substance of management.

Tables for Computation of Air Flow Through H.E.I. Standard Flow Nozzles, by Philip Freneau and Riley Grippen; Heat Exchange Institute, New York, 1945; 22 pages, $1.00.

The Steam Jet Ejector and Vacuum Cooling Section of the Heat Exchange Institute has developed standard orifices or flow nozzles, specifically designed for the measurement of airflow in the steam-jet ejector industry. These tables have been prepared for the convenient solution of the recommended flow formulas.

Internal Combustion Engine Lubrication Research at Pennsylvania State College, by Harold A. Everett; The Council on Research, The Pennsylvania State College, State College, Pa., 1944; 34 pages.

Some of the more important recent activities of The Pennsylvania State College in the field of lubrication research are summarized in this bulletin. Investigations of lubrication phenomena encountered in the modern internal-combustion engine are described.

Airport Reference, 5th Annual, 1945–46; Occidental Publishing Company, Los Angeles, 1945; 128 pages, $2.00.

The latest edition of a reference book compiled as the result of special surveys and research embracing a large number of reports and other publications on various phases of airport construction and operation. An airport-equipment directory and a personnel directory of the principal associations and administrations allied to the airport field are included. A section is devoted to data on transport aircraft.

Airport Plan, prepared for the Detroit Metropolitan Aviation Planning Authority by Horner and Shifrin and by Smith, Hinchman and Grylls, Inc., Detroit, 1945; 173 pages.

A report on a regional study and regional plan for the development of all types of aviation in the Detroit metropolitan area. It also contains recommendations for the type of authority to administer the plan.

The Theory of Sound, by John William Strutt, Baron Rayleigh; Dover Publications, New York, 1945; 504 pages, $4.95.

The first American edition of Lord Rayleigh's book on the subject of sound, which was first published in two volumes in 1877 and brought out in revised and enlarged form in 1894. The first half of the book (Volume I of the original edition) discusses the vibrations of dynamical systems. The second half of the book (originally Volume II) is devoted to other aspects of the theory of sound.

Both sections contain fundamental data applicable to the aeronautical sciences. Chapters in the first part refer to vibrating systems in general; longitudinal, torsional, and lateral vibration of bars and vibrations of plates, curved plates or shells. In the second part, chapters relating to theories of aerodynamics include those dealing with aerial vibrations, compression of air, applications of Laplace's functions, spherical layers of air, fluid friction, wave motion, the plane vortex sheet, vibrations of solid bodies, and others.

Plastics in Practice, by John Sasso and Michael A. Brown, Jr.; McGraw-Hill Book Company, Inc., New York, 1945; 185 pages, $4.00.

Arranged to provide information about plastic materials and processes by means of specific applications, this book contains more than 100 case studies. Each study typifies the use of a particular plastic or fabricating method. The book is divided into two sections, the first of which is devoted to proved commercial applications of plastics and the second to new developments.

Japanese-Chinese-English Dictionary of Aeronautical and Meteorological Terms, by Stanley Gerr; G. E. Stechert & Company, New York, 1945; 439 pages, $8.00..

This dictionary is arranged in the regular Sino-Japanese character-dictionary order based on radical and stroke. It includes translations in the three languages of terms relative to aerodynamics, hydrodynamics, airplane construction, stress analysis, propeller theory, internal-combustion engines, airports, ground installations, and meteorology. There is also a section in kana.

Hilfsbuch fuer die Praktische Werkstoffabnahme in der Metallindustrie (Manual on Practical Material Testing in the Metal Industry), by E. Damerow and A. Herr; Springer-Verlag, Berlin, 1941; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1945; 117 pages, $3.75.

In order to make dependable and coherent calculations of all mechanical technologic investigations rapidly, the authors have attempted to use, extend, and take advantage of all previous test results. In the first part of the book the conventional testing methods are discussed in detail, their rules of procedure are developed in a popular manner, and if necessary are explained by means of examples. Parts 2 and 3 present a compilation of tables giving data on strength, expansion, contraction, and hardness. The tables of Part 4 show the relations toward one another of hardness data resulting from the various testing methods, and their comparison with the strength data.

The book contains 35 illustrations and 75 tables. Most of these tables have been the property of the material-testing laboratory of the Rheinmetall-Borsig A.-G. and are made public for the first time in this book.

Einfuehrung in die Algebraische Geometrie (Introduction to Algebraic Geometry), by B. L. Van der Waerden; Julius Springer, Berlin, 1939; published and distributed under the authority of the Alien Property Custodian by Dover Publications, New York, 1945; 247 pages, $3.50.

Algebraic geometry is stated to be the result of the combination of the highly developed theory of algebraic curves and surfaces of the German school, with the multidimensional geometry of the Italian school. Lately it has received a fresh impetus by the introduction of topology. In this combination, algebra proper examines the principles, and the scope of this book is not meant to go beyond those principles.

The aim of the author is to prepare the necessary objective material before developing the general conceptions.

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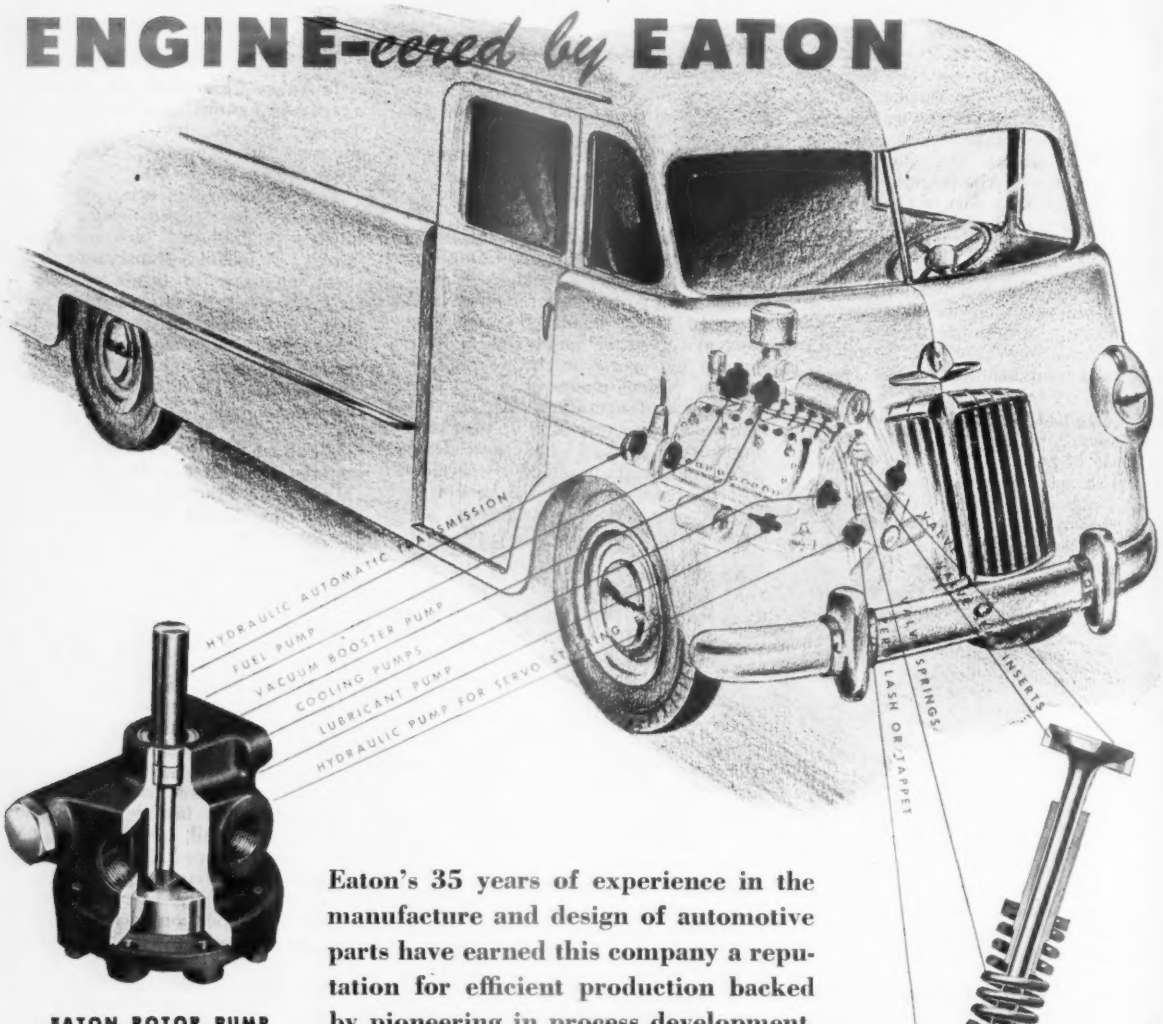

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He discusses many separate geometric problems in order to explain the methods and so prepare the questions as far as the limited size of the book permits.

Theoretische Einfuehrung in die Gasdynamik (Theoretical Introduction to the Dynamics of Gases), by Robert Sauer; Springer-Verlag, Berlin, 1943; published and distributed in the public interest by authority of the Alien Property Custodian by Edwards Brothers, Inc., Ann Arbor, Mich., 1945; 146 pages, $4.50.

Based on a series of lectures given by the author under the auspices of the Aachen Aerodynamic Institute, the aim of this book is to give a comprehensive representation of more recent investigations on gaseous flow at high velocities. As the title indicates, it deals mainly with the theoretic mathematical treatment of the problems. Experimental and testing problems are not considered. There is a further limitation in the assumption that the flow is stationary, and that friction and heat conductivity are disregarded.

The effect of compressibility is included in the study. The scope of the book is such that not only the two-dimensional flow is discussed, but also the symmetric axial flow as being the most important case of three-dimensional flow.

Die Theorie der Gruppen von Endlicher Ordnung mit Anwendungen auf Algebraische Zahlen und Gleichungen Sowie auf die Krystallographie (Theory of Groups of the Finite Order, with Applications to Algebraic Numbers and Equations and to Crystallography), by Andreas Speiser; Julius Springer, Berlin, 1927; published and distributed in the public interest by authority of the Alien Property Custodian by Dover Publications, New York, 1945; 262 pages, $3.50.

According to the author, the theory of groups consists, in its elementary part, of a series of methods and terms which perhaps are not always entirely coherent organically. In the arrangement of this collection of individual representations, special attention has been given to the applications.

In addition to various algebraic and theoretic numerical statements, crystallography is given special consideration. As compared with all other cases of mathematical description of natural bodies, crystallography has the advantage of greatest simplicity of conception and strictest arithmetical precision.

The theory of substitutional groups forms an important systematic theory which is presented at the end of the book.

Fiction and Juvenile Books

Black Moon, by Clark McMeekin; D. Appleton-Century Company, Inc., New York, 1945; 238 pages, $2.75.

Dorothy Park Clark and Isabel McLennan McMeekin (names combined to form the pen name of Clark McMeekin), have written a novel of the period when ballooning was a popular form of exhibition, beginning about 1830. The central figure is a daring balloonist who makes an ascent at Pittsburgh, lands near a circus boat on the Ohio River, and is taken aboard and nursed back to health while the showboat troupe performs at the river towns. At Cincinnati, the balloonist is induced to try out a primitive glider. At Louisville he makes an ascent in one of Clayton's balloons.

The historical background adds interest to a romantic adventure story.

Give Me New Wings, by Elizabeth Hoy; Arcadia House, Inc., New York, 1945; 272 pages, $2.00.

A Royal Air Force pilot makes a parachute landing on the grounds of a clinic supervised by a young English woman physician. The locale is Spanish Morocco. A romance follows, which is complicated by the officer's escape across the border into French North Africa and his return to England during the bombing raids. However, the R.A.F. pilot assists in the rescue of the doctor and all ends well.

The Twenty-Fifth Mission, by Loring MacKaye; Longmans, Green and Company, Inc., New York, 1945; 214 pages, $2.00.

The tail gunner of a Flying Fortress bails out over Denmark after an attack by the Germans. He and other members of the crew join the Danish underground and engage in street shooting in Copenhagen. They make their escape in a sailboat to Sweden and have more experiences with enemy patrolling craft. The central figure of the story is a typical 17-year-old American lad named "Jigs" who shows his courage and determination all through the tale.

The Journey Home, by Zelda Popkin; J. B. Lippincott Company, Philadelphia, 1945; 224 pages, $2.50.

A bombardier returns from overseas and receives a 3-weeks' leave. Through the black market in Miami he secures a ticket to his home in New York. The novel is about the people he encounters on the trip north. The conversations about the war and home conditions are of a kind that irritate the returned officer and make him wonder what his fighting was for. A romance commences and evidently has a happy ending.

The book is written without reserve and is intended to stir the emotions of people who were complacent about the war.

Toby Can Fly, by Lois Maloy; Grosset & Dunlap, New York, 1945; 30 pages, $0.50.

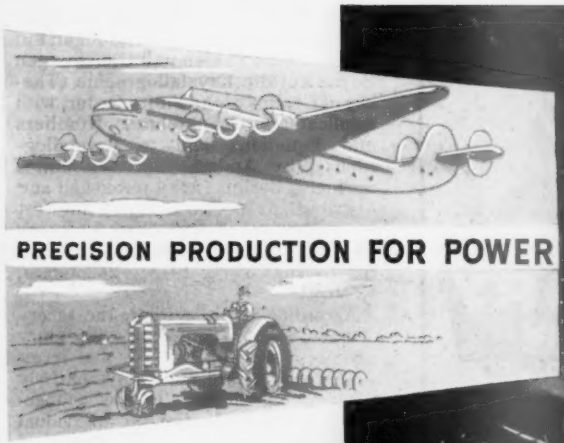
A children's book, illustrated in color for the youngest member of the family. Little Toby does almost everything but believes that he cannot fly. With the encouragement of a "humanized" airplane he is enabled to vie with the birds in the air.

Yu Lan: Flying Boy of China, by Pearl S. Buck; The John Day Company, New York, 1945; 60 pages, $1.50.

The distinguished author of many books on China has written another book for children. This is the fifth juvenile book in the series and tells the story of a boy on a Chinese farm who wanted to learn everything about airplanes. An American pilot makes an emergency landing near Yu Lan's home and is assisted by the boy's parents. During the visit Yu Lan learns how an airplane operates and at the end is taken on a flight back to the American flying field.

A Yankee Flier on a Rescue Mission, by Al Avery; Grosset & Dunlap, New York, 1945; 210 pages, $0.60.

Al Avery again writes a story of three A.A.F. pilots who make a rescue of one of the group who was captured and put in a German prison. It is of the thriller type of novel and packs one hair-raising exploit after another.



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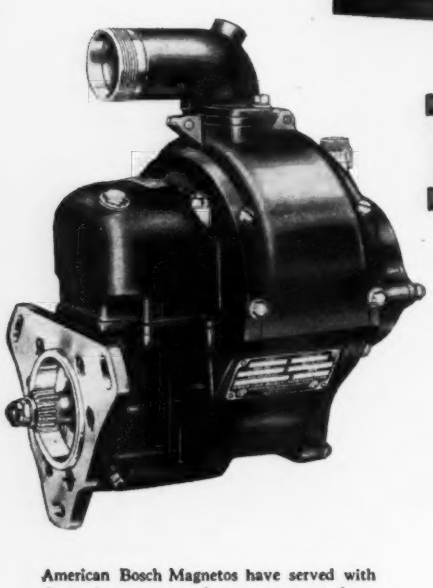

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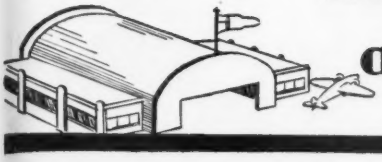

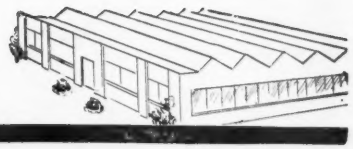

To Reduce Production Costs

Production and Cost Control. A 47-page booklet prepared primarily for the use of supervisory personnel gives suggestions for reducing the cost of operation in aircraft manufacture. Through the use of cartoons and captions, information is conveyed with regard to the manufacturer's Production and Cost Control Plan. The plan involves six major control methods designated as cost centers; standard operations; standard times; units produced; work in process; and cost-center labor. In addition to the cartoons there are reproductions of operation sheets and other accounting forms used under the plan. *Lockheed Aircraft Corporation.*

Aluminum Data Books

Alcoa Aluminum and Its Alloys. The revised edition, designated 1944A, of a ring-bound data book, gives in concise form some of the fundamental information concerning the alloys of Alcoa aluminum, including the properties, applications, forms, and sizes in current commercial production.

The first section contains general information concerning the production of aluminum and its physical and chemical properties. The second section deals with wrought alloys and products made therefrom, as well as the heat-treatments to which they are subjected. The third section gives information about aluminum-alloy castings, including the types and designs, and the fourth section explains the fabricating practices. In addition to the text, there are many tables containing essential technical data.

An Outline of Aluminum is a booklet of 64 pages designed to acquaint workmen in industrial training classes with the properties of aluminum and to give correlated material concerning the metal to high-school students in the arts, vocational education, social studies, and science classes. Being an outline, the booklet does not go into detail but emphasizes the basic facts. Questions have been included in the appendix to aid in the study of the outline. In some instances questions require original work on the part of the student.

Riveting Alcoa Aluminum and Its Alloys. A revised edition of a 46-page handbook supplies current information regarding the technique of riveting structures made of aluminum and its alloys. It includes text and tables giving technical data about the strength and other properties of sheets and other forms of commercial aluminum, and the rivets used to join such structures. *Aluminum Company of America.*

Hydraulic Unit for Propeller Feathering

Pesco Electric Motor-Driven Feathering Pump Model 1E-777-AC is described in a 4-page bulletin. It outlines the principles of operation of an improved motor-driven hydraulic pump specifically designed for feathering aircraft propellers. The operation of the unit is explained and specifications are given with regard to its size, capacity, and performance. *Bulletin 1E-3, Pesco Products Company Division of Borg-Warner Corporation,* Cleveland.

Scientific Developments for War

We Did It This Way is an illustrated booklet of 32 pages which traces a few of the applications of scientific research and engineering to the development of war materials. It examines some of the achievements by which telephone engineers utilized their talents in the invention and production of some of the devices that aided the Allied armed forces in the Second World War. It tells briefly of the radio systems for tanks, battle announcing systems for naval ships, gun directors for land and sea forces, and radio and telephone systems for land armies. *Western Electric Company,* New York.

Additional Use of Chemical Bonding of Metals

Al-Fin Bonding Solves Heat Transfer Problems. Marshall G. Whitfield and Victor Sheshunoff. A review of the applications of the Al-Fin process of chemically joining aluminum and its alloys to various ferrous metals gives details about applications of the process other than that by which the cooling fins are attached to the barrel of an aircraft-engine cylinder. Among the new uses described are bearings, discharge tubes, air-cooled radio-transmission power tubes, heat exchangers, economizer tubes for steam boilers, and oxidation-resisting parts in oil-refinery equipment. Aluminum camshaft gears with Al-Fin bonded steel hubs are expected to provide improved strength and service life. Additional information is given about recent experiences with the application of the process for cooling aircraft-engine cylinders. *The Pegasus,* October, 1945.

Casting Resins

Durez Casting Resin is the title of a booklet containing technical details about the use of phenolic casting resin for dies, jigs, fixtures, foundry patterns, models, and the masking shields for plating and painting. It describes the process of manufacture of the material and the various uses for which it is suitable, and gives tables of the properties and other technical data. *Durez Plastics & Chemicals, Inc.,* North Tonawanda, N.Y.

Diversified Industrial Products

Allis-Chalmers 1944 Annual Review traces the engineering developments and the scope of the activities of a manufacturer of machinery and electrical equipment. The 80-page illustrated booklet outlines the products and services of the company under headings of power generation, power distribution, processing, general industrial applications, construction, agriculture, transportation, and research.

In the transportation section, one chapter records the manufacturer's contributions to the aeronautical industry, in the form of gas turbines and geared-type superchargers and equipment for use in wind tunnels and elsewhere. *Allis-Chalmers Manufacturing Company,* Milwaukee.

Aircraft Compasses

Bendix Automatic Radio Compass. The MN-31 series of the Bendix automatic radio compass is described in an illustrated booklet which outlines the salient features of this instrument and gives performance specifications.

Specifications of the MS-105A VHF broad-band antenna are given in a separate 4-page folder. *Bendix Radio Division of Bendix Aviation Corporation.*

Small Transport Aircraft

Norseman is the title of a ring-bound illustrated catalog of 23 pages which reviews the war services and civilian applications of the Noorduyn Norseman transport airplane. The war services of the Norseman as a training aircraft for transport work among distant outposts are traced. Specifications of the current model with modifications for civilian use, as well as performance charts and other data are included. *Noorduyn Aviation Limited,* Montreal, Canada.

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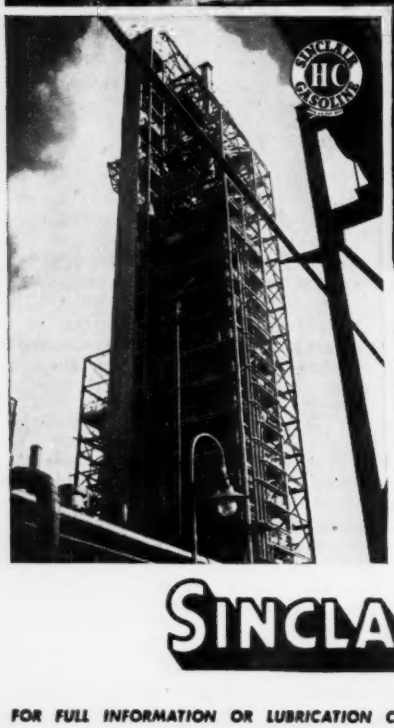

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Everything for Gliding and Soaring is a 4-page leaflet showing peacetime gliders, sailplanes, and other equipment for civilian gliding and soaring. It contains brief descriptions, illustrations, and specifications of current and future models of utility gliders and sailplanes, as well as supplies and equipment for motorless flight. *Schweizer Aircraft Corporation*, Elmira, N.Y.

Metallizing in Aircraft Manufacture

Metallizing at Lockheed. Fred M. Burt. Examples of the use of the metallizing process in aircraft tooling are given in a description of the work carried out by the tooling division of Lockheed Aircraft Corporation at its plant in Burbank, Calif., where new tools, jigs, and fixtures are constructed and reworked. Salvage of spot-welding equipment is one of the processes featured. Other savings of time, labor, and material are revealed with regard to the Keller and Hydro-Tel profiling machines. Similar methods used in making reinforced metal shells are noted and details are given about the efficiency achieved in machine-tool maintenance. *Metco News*, July-August, 1945.

Aerial Photographic Equipment

Kodak Materials for Aerial Photography is a 24-page catalog containing information about Kodak Aero Films. A brief summary of the properties of the film is given in the introductory pages, followed by a detailed data sheet for each type of film. Some of the sensitized materials for laboratory work in aerial mapping are described, as well as the Wratten filters for aerial photography. Manufacturer's recommendations for film storage are included. *Eastman Kodak Company.*

Folder on Tubing Tools

Imperial Tubing Service Tools. A tube-working tool selector is featured in a new folder on tubing tools intended for use with copper, brass, aluminum, thin-wall steel, and similar tubing. The folder includes specifications for flaring tools, tube cutters, tube benders, coil makers, pinch-off tools, swedging tools, reamers, refacing tools, and soldering equipment. *Folder No. 347, The Imperial Brass Manufacturing Company*, Chicago.

Vibration-Fatigue Testing

Bulletin 1007 describes equipment for testing vibration fatigue. The manufacturer's Model 100 VA is designed to test units weighing up to 100 lbs. by producing vibration vertically in simple harmonic motion. The machine is equipped with an automatic acceleration-changing control giving a range of frequency from 10 to 60 cycles per sec. in an automatic cycle, or it can be controlled manually. Frequencies are recorded on an electrical tachometer. Typical installations in the laboratories of manufacturers of electronic and industrial equipment are illustrated, and specifications are given for the Model 100 VA and seven other units for different applications and capacities. *All American Tool & Manufacturing Company*, Chicago.

Synthetic Rubber Program

Bricks Without Straw. The story of the synthetic rubber program as developed by The B. F. Goodrich Company is reported in a 45-page book. Beginning with May, 1940, when it was realized that war conditions would imperil the nation's supplies of natural rubber and that a satisfactory synthetic rubber had to be found, the book traces the steps taken, giving a brief outline of the research work that led to the production of synthetic material for tires and for other uses as an acceptable substitute for the natural product. The closing pages contain illustrations of the manufacturing equipment that is now producing large quantities of synthetic rubber. *The B. F. Goodrich Company.*

Silicone Products

Dow Corning Silicones. A recently issued catalog lists all of the new Dow Corning silicone products and contains charts showing the properties of this group of organo-silicon-oxide polymers. These silicones are produced in many forms including fluids, greases and compounds, resins and varnishes, and Silastic, the manufacturer's silicone rubber.

All of these classes of silicone products and many special formulations among each of them are described, and industrial uses are suggested for these heat-stable, waterproof materials. *Dow Corning Corporation*, Midland, Mich.

Achievements of Research

Firestone Research is the title of a 37-page illustrated booklet tracing the functions of industrial research, with particular reference to the contributions of scientific research in the rubber and related industries. The manufacturer's new research laboratories and the work being performed there, as well as the results of earlier research work and the products that were developed are described. The making of the manufacturer's Butaprene synthetic rubber is traced from the raw materials to the finished products. A section is given to the contributions of the company to the manufacture of aircraft and aircraft accessories. *The Firestone Tire & Rubber Company.*

Tool Steels

The Tool Steels of Allegheny Ludlum. A tab-indexed, ring-bound data book contains technical text and tables about the properties of tool steels and their applications. The first section describes the five fundamental groups of tool steel, designated as the high-speed steels, hot-work steels, shock-resisting steels, cold-work steels, and the carbon and low-alloy steels. Each of these is made to meet certain specific production problems, of which explanations are given. Other sections deal with the forms and applications of tool steels and the specific work they are intended to perform. *Allegheny Ludlum Steel Corporation.*

Aero Research Technical Notes

Making Plywood with Aerodux 14 is one of a series of technical notes. It tells about the properties and uses of Aerodux 14, a dry powder designed to fill the need for a hot-pressing resin adhesive possessing extreme water resistance but which can be applied as a liquid. The material is prepared for use in the production of flat plywood, curved plywood by the rubber-bag process, and for a variety of specialized uses. *Bulletin No. 33, Director of Research and Development, Aero Research Limited*, Duxford, Cambridge, England, September, 1945.

Photographic Art Work

Photo Art in the Aircraft Engine Field is a catalog of selected photographs prepared for use in advertising and other forms of publicity, portraying the range of the activities of a leading manufacturer of aircraft engines. The views show the precision operations required in the manufacture of such products, as well as the actual production processes, and indicate the scope of the manufacturer's research work. *Wright Aeronautical Corporation.*

Scale-Drawing Materials

Detail Engineers'-Glass and Universal Layout Scale for Form Grinders are illustrated and described in a 4-page folder. This material is designed to make possible scale drawing within limits of fractional thousandths of an inch without mathematical calculations, with the use of form and profile grinders. The glass carries a graph of blue lines spaced at intervals indicating 0.001 in. at 50 magnifications, over which is placed a hard sheet of thin vellum. The use of the material and related instruments and accessories are detailed. *Engineers Specialties Division of the Universal Engraving & Colorplate Company, Inc.*, Buffalo, N.Y.

Protective Coating for Mechanical Equipment

Dipwrap—Hot Dip Protective Compound. Technical Service Bulletin No. 14 describes Dipwrap hot-dip protective compound. This compound is represented as a coating providing protection for the packaging, shipment, and storage of mechanical parts and tools. Specifications for the coating and directions for using it are given. *Paisley Products, Inc.*, Chicago.

Gear Standards

A.G.M.A. Standards. The current American Gear Manufacturers Association standards and tentative standard sheets are bound in loose-leaf form so that subsequent sheets may be added.

Sections give the terms used in designating gear-tooth wear and failure, and the symbols used in gear engineering. Data sheets are provided listing standards of surface durability, beam strength, and lubrication. Other sheets refer to corrosion prevention and other technical details, as well as standards of design, production, and use of various forms of gears. *American Gear Manufacturers Association*, Pittsburgh.

Boring and Milling Machine

Model 3-B DeVlieg Jigmil is an 8-page folder describing a new type of boring and milling machine that provides automatic positioning and a means of control of accuracy, through the use of push-button controls. It is stated by the manufacturer that all bar functions can be performed while the operator's visual attention is given solely to the cutting tool. *DeVlieg Machine Company*, Detroit.

Metal for Gears

Ampco Metal in Gears. The use of aluminum bronze in gear applications is featured in a 4-page bulletin. The properties of this alloy are listed and a table is included showing the grades recommended by the manufacturer for various types of gear services. The bulletin points out the common cases of gear trouble indicated as breakage, deformation, flaking and pitting of the teeth, and specifies the properties of the alloy designed to eliminate these difficulties. *Bulletin 55, Ampco Metal, Inc.*, Milwaukee.

Commercial Hydride Process

The Hydride Process and Its Products outlines the process devised for the production of various hydrides on a commercial scale, the utilization of their special properties in the production of pure metals and alloys, and the generation of pure active hydrogen. Besides a description of the process, the 18-page booklet gives the chemical properties of metallic hydrides, with sections referring to titanium, titanizing, zirconium, titanium-copper alloys, method of addition of titanium to copper, zirconium-copper alloys, special metals, and powdered alloys.

A list of Hydrimet products is included, as well as a graph showing the hydrogen content per pound of commercial grades of certain metallic hydrides. *Metal Hydrides Incorporated*, Beverly, Mass.

Educational Motion Pictures and Filmstrips

Airplane Maintenance is a 12-page pamphlet containing a list of educational motion pictures and filmstrips that show how to perform specific jobs. The filmstrips review and clarify important points in the motion pictures. Brief descriptions are given of each film, together with its running time and price. The films were produced by the Federal Security Agency, U.S. Office of Education.

Visual Aids for Science Classes. A group of motion pictures, filmstrips, and instructor's manuals contains a list of available films for educational use in connection with electronics, materials testing, calculation, and measurement. Brief descriptions of each film are given, together with prices, running time, and other details.

A list of Army and Navy motion pictures and filmstrips is included, these having been released by the War and Navy Departments to the U.S. Office of Education for distribution to schools and other civilian agencies engaged in war training. The subjects refer to meteorology, aerodynamics, celestial navigation, radio and electronics, and related subjects. *Castle Films*, New York.

Protection of Tapped Threads

Heli-Coil Screw Thread Inserts and the Aero-Thread Screw Thread System. Bulletin No. 239 is a 4-page folder containing descriptions of methods for protecting taped threads in products made of light metals and plastics by means of Heli-Coil and Aero-Thread Inserts. These inserts are used in the aircraft industry for spark-plug bushings, stub bushings, and many other applications, and it is stated that its principles are applicable wherever light metals, plastics, and metals of relatively low tensile strength and hardness are

Low Weight... Compactness

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WITH A

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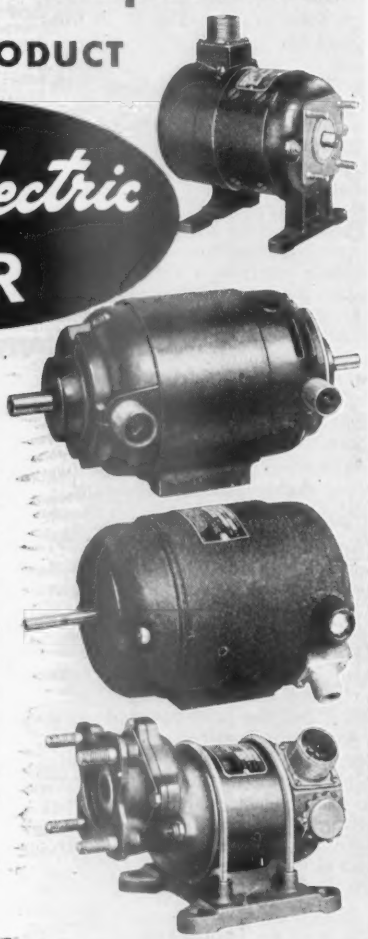

30 YEARS' experience designing and building fractional horsepower motors for all types of special applications has taught us where and how much *motor* weight can be reduced without interfering with essential electrical characteristics. Our knowledge of products gained by close cooperation with many types of manufacturers frequently enables us to make design suggestions that reduce *product* weight, as well as improve compactness. It is best to discuss the motor while your products are in the *early stages* of development.

THE LAMB ELECTRIC COMPANY
Kent, Ohio

Lamb Electric
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SPECIAL APPLICATION FRACTIONAL HORSEPOWER MOTORS

used. Photographs and drawings illustrate several applications. *Aircraft Screw Products Company, Inc.*, Long Island City, N.Y.

Medium-Pressure Hose Assemblies

Bulletin No. 104 describes and illustrates medium-pressure hose assemblies that are stated to offer advantages from the inventory standpoint, as well as in the matter of utility. Standardized fittings simplify inventory problems by providing a wide range of combinations, dimensions, and other specifications for reusable fittings, adapters, and subassemblies for medium-pressure flexible hose. *Aeroquip Corporation*, Jackson, Mich.

Threadless Connections for Tubing

How to Cash in on the Silver Alloy Ring illustrates a method for making threadless connections and bonding copper tubing or brass pipe into a single pipe line. The booklet shows how Silbraz joints are made by the use of patented bronze pipe fittings, valves, and flanges containing a ring of silver brazing alloy in each port opening. It is stated that when brass pipe or copper tubing is properly inserted in these fittings and the assembly is brazed, the resulting joint becomes stronger than the pipe itself, providing a leak-proof joint that will not creep or pull apart under any pressure that can be withstood by the pipe itself. Photographs and text illustrate how the joints resist corrosion and vibration, and how they simplify and speed up installation.

Other explanatory sections describe the Aircobraze outfit for making these joints and the many uses for the equipment. *Air Reduction Sales Company*, New York.

Needle-Bearing Data

Torrington Needle Bearings. The 32nd edition of a ring-bound data book gives engineering and application details of needle bearings. After a general description of the design and manufacture of this type of bearings, detailed technical information is given for the necessary calculations for applying them in a wide range of industries.

The data include engineering formulas, drawings, and specification tables. A special section is assigned to bearings for aircraft use. *The Torrington Company*, Torrington, Conn.

Catalog of Screw Products

Stronghold Screw Products. A ring-bound catalog contains extensive lists of specifications and illustrations of a wide variety of screw products. Index tabs facilitate the location of desired information on specific types of screws. One section is assigned to aviation products and contains 36 pages of data referring to screw products designed for aircraft use and conforming with Army and Navy specifications. *Manufacturers Screw Products*, Chicago.

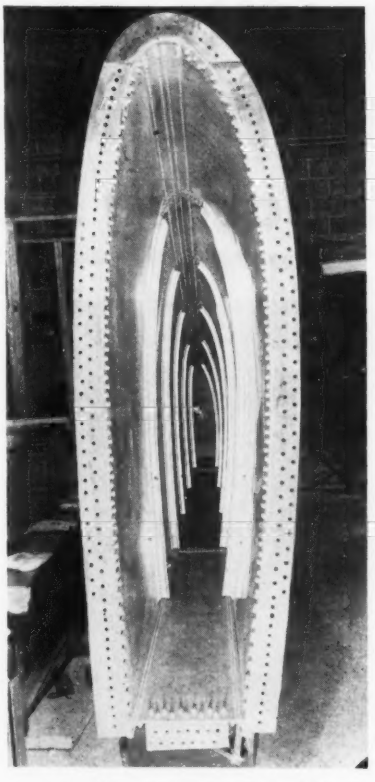


Photo Courtesy Dow Chemical Company

Illustrating monocoque magnesium wing construction, the above photograph shows the elimination of all complicated interior structure. Structural tests are stated to show that by this method a simpler and aerodynamically better structure can be built without increasing the weight.

Production and Use of Magnesium

Information Please. . . . The history of the Bay City Fabrication Department of The Dow Chemical Company is briefly reviewed, tracing its operations from the time when a small unit was detached from the Midland plant and assigned the task of fabricating products from magnesium sheet and extrusions. The article tells how the techniques of fabricating magnesium were developed, and of the growth of the field in which the metal has been found useful. Details are given about the processes of drawing, forming, and bending magnesium sheet, as well as the methods of welding it. Emphasis is placed on the use of the metal in aircraft construction with particular reference to the wings, for which a new type of construction has been developed. *The Dow Diamond*, August, 1945.

Aircraft Bearings

Norma-Hoffmann Precision Aircraft Bearings are described in a 36-page catalog. The bearings are intended primarily for use in aircraft-control equipment. The information consists of brief descriptions, drawings, and tabulated specifications of a wide range of ball bearings in English and metric measurements. *Norma-Hoffmann Bearings Corporation*, Stamford, Conn.

Private Flying—Bibliography

(*Continued from page 33*)

Suggested Economical . . . Northern Work Horse . . . Described in Detail, by R. F. Corless, Jr.; *Canadian Aviation*, March, 1945, Vol. 18, No. 3, pp. 55–56, 82.

Under Present Regulations . . . You Can't Afford Storage . . . for Your Private Planes; *Canadian Aviation*, March, 1945, Vol. 18, No. 3, p. 60.

Canadian Clubs Seek Low Flight Rates; *Aviation News*, March 12, 1945, Vol. 3, No. 7, p. 39.

Not Quite the Answer [Financial Post Survey]; *Canadian Aviation*, April, 1945, Vol. 18, No. 4, p. 69.

Canadian Lightplane Sales Plan Formed; *Aviation News*, July 2, 1945, Vol. 3, No. 23, p. 19.

Report from the Flying Clubs; *Canadian Aviation*, September, 1945, Vol. 18, No. 9, pp. 48–49.

Great Britain

Planning the Future of Civil Flying [organization of flying clubs], by M. de Bunsen; *Aeronautics*, February, 1941, pp. 47–48.

The Air Ministry's Disinherited [Light Aeroplane Clubs]; *Aeroplane*, February 7, 1941, Vol. 60, pp. 158–159.

What Happened in England, by William Courtney; *Air Trails*, March, 1942, Vol. 17, No. 6, pp. 14, 48–49.

A Flying Start after the War, by A. James Payne; *Great Britain and the East*, London, July 3, 1943, Vol. 60, No. 1675, pp. 21–22, 30.

Small Fry; *Aeroplane*, January 21, 1944, Vol. 66, p. 75.

Postwar Private Flying, by James C. Fitzmaurice; *Flight*, London, October 5, 1944, Vol. 46, pp. 373–375.

Aeromotoring Tomorrow—or not? by Cyril May; *Aeronautics*, April, 1945, Vol. 12, No. 3, pp. 38–39.

A Plan for Private Flying; *Aeroplane*, April 13, 1945, Vol. 68, p. 423.

Private Flying; *Flight*, April 26, 1945, Vol. 47, p. 456.

Government Attention to Private Flying Urged [by Royal Aero Club and the Automobile Association]; *International Aviation*, May 18, 1945, Vol. 2, p. 325.

British Pilots to Get Go-ahead; *Aviation News* May 28, 1945, Vol. 3, No. 18, p. 21.

Post-war Private Flying Policy, by P. A. Wills; *Aeronautics*, July, 1945, Vol. 121, No. 6, p. 53.

Lightplane Shortage Faces British Pilots; *Aviation News*, July 9, 1945, Vol. 3, No. 24, pp. 36, 38.

Flying Clubs After the War, by A. J. Deane-Drummond; *Aeroplane*, June 29, 1945, Vol. 68, p. 744.

Freeing the Private Pilot, by Adrian Chamier; *Aeronautics*, September, 1945, Vol. 13, No. 2, p. 70.

What the Private Owner Does Want! A Review of Pre-war Types and Some Suggestions, by Ernest P. Brodie; *Flight*, September, 13, 1945, Vol. 48, pp. 275–276, 278.

Latin America

Una Idea Para Los Clubes Aereos Del Sur, por Guy de Moras; *Aeronáutica*, September, 1944, Vol. 1, No. 3, pp. 18–19.

Escadrille Private Flyers Study First Inter-American Conference, by Alexander McSurely; *Aviation News*, February 12, 1945, Vol. 3, pp. 17–18.

Argentina Auto-airport Network Being Built Now by Motor Club, by Alexander McSurely; *Aviation News*, May 14, 1945, Vol. 3, No. 16, pp. 41–45.

Brazilian Planes for Private Clubs; *International Aviation*, June 8, 1945, Vol. 2, p. 356.

BIBLIOGRAPHY

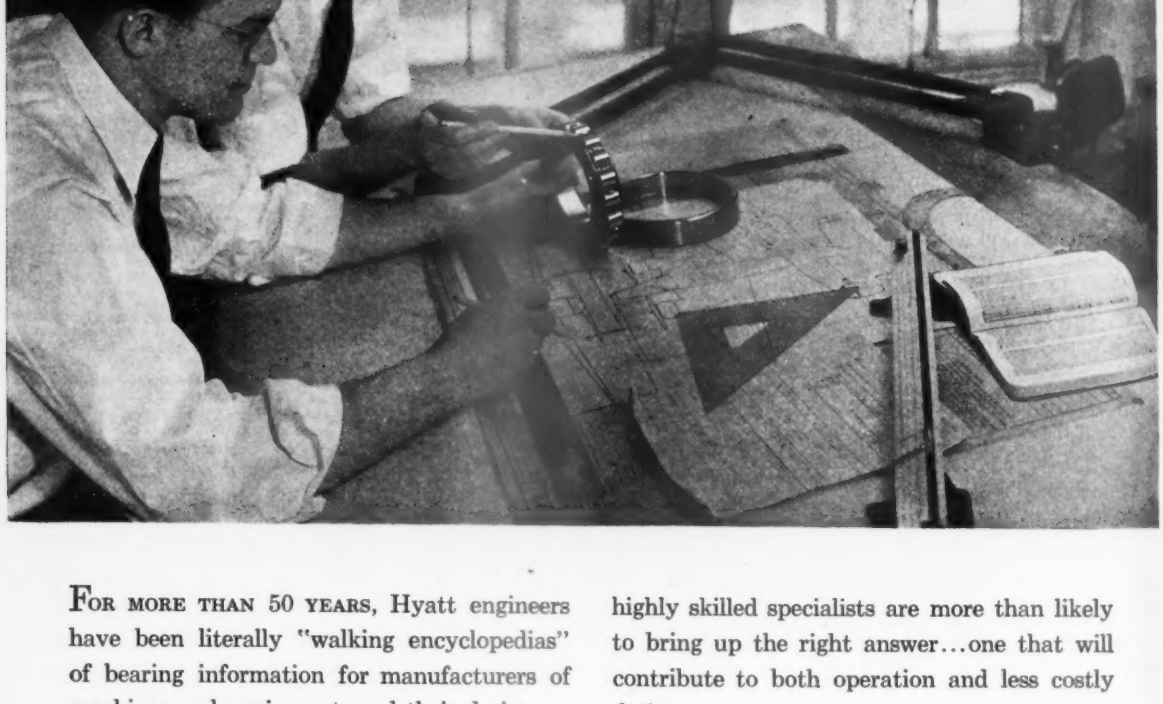
Articles and publications issued prior to those listed may be found in the following bibliographies.

Aircraft Uses. *In* U.S. Works Progress Administration. Bibliography of Aeronautics. New York, 1939. 37 pp. [Typewritten] Includes Sports Flying, Private Flying, and Light Airplanes.

Bibliography on Light Airplanes. Washington, D.C., Civil Aeronautics Authority Library, July 14, 1939. 2 pp.

FOR YOUR INFORMATION....

Human Handbooks of Bearing Data



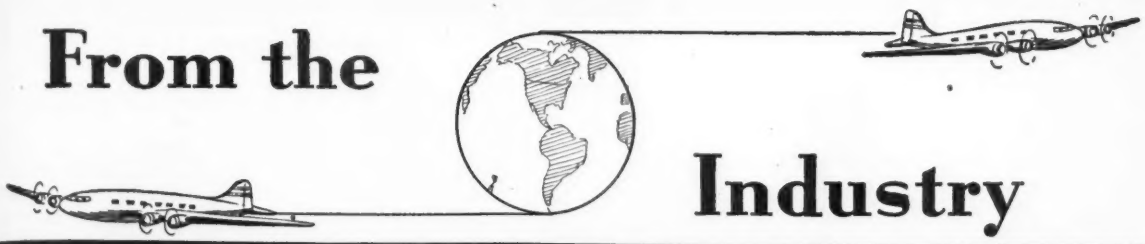
FOR MORE THAN 50 YEARS, Hyatt engineers have been literally "walking encyclopedias" of bearing information for manufacturers of machines and equipment, and their designers.

During this time these men have accumulated a tremendous fund of technical knowledge of the application of Hyatt Roller Bearings. In this vast reservoir of experience, there may already be solutions to the mechanical obstacles that you encounter in the products you are developing or improving today. Even if there has not been a problem to parallel yours, these highly skilled specialists are more than likely to bring up the right answer...one that will contribute to both operation and less costly designs.

Consultation with Hyatt engineers is easy to arrange, involves no obligation. They are glad to come to you in a spirit of interested helpfulness and proud of the opportunity to work constructively with you in the selection of proper bearings for your products. Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

HYATT ROLLER BEARINGS

From the Industry



Releases are printed as received from companies and other aeronautical organizations and the responsibility for the accuracy of all statements is therefore not assumed by the Aeronautical Engineering Review.

Complete Airport Radio Station Equipment

A complete airport radio station can be purchased, ready to plug into a socket and start working. The only exception is the antenna-supporting poles which do not come with the equipment. Simple, push-button control operates the sets, which require no dialing or tuning as each channel is pretuned and controlled by radio crystals. The station is designed for airports, air lines, and other similar types of communications systems. It may be used for point-to-point or ground-to-plane communication or as a tower-control station.

A feature of the station equipment is that it can be operated by third-class operator personnel since all tuning adjustments and all components are enclosed. The only operation controls required are the mechanically interlocking push buttons and a hand or foot push-to-talk switch.

Other features of this ready-to-use station include two-channel telephone emission with frequency ranges for both day and night operation, and 100 per cent modulation in all frequency ranges. The channel range is from 2.0 to 8.0 megacycles, 200 to 410 kilocycles, or 118 to 132 megacycles, with other frequencies available on special order.

Designed for airport traffic control and weather information, the 50-watt radio station is expected to make a suitable station for fields where cross-country, feeder-line, charter service, and heavy transient flying make traffic regulation necessary. Aireon Manufacturing Corporation.

New Light Plane

All American Aircraft, Inc., is introducing its Model 10, called the Ensign, an all-metal, 85-hp. light plane with tricycle landing gear and full-vision enclosure. The plane is expected to be available for purchase in December and the production program calls for building 1,000 to 5,000 units during 1946.

Descriptive data given on Model 10 are as follows: two-place; all-metal construction; 85 hp.; tricycle landing gear; self-starter; differential hydraulic brakes; cruising speed, 115 m.p.h.; cruising range, 500 miles; maximum speed, 125 m.p.h.; landing speed, 50 m.p.h.; rate of climb, 700 ft. per min.; service ceiling, 14,000 ft.; useful load, 550 lbs. Other models will be available with increased power and performance, retractable landing gear, flaps, and a two-control system. All American Aircraft, Inc.

Improved Control Cables

As a result of a recent development in steel cables, airplanes of the future are expected to have more flexible and efficient controls. The newly developed cable performs the same functions as former types while banishing a number of aircraft-engineering difficulties, through its ability to expand and contract in varying temperatures at almost the same rate as duralumin. The virtual elimination of the discrepancy in the expansion coefficients of the two metals has made it possible to dispense with special compensating devices.

The steel in the new control cables is a high nickel-manganese alloy formerly used for making hold-down devices for aluminum housings. Because of the special analysis of the material, it requires an entirely different practice in wire-drawing technique to effect utilization of its maximum beneficial properties. All types of aircraft control cables are being produced from the new material, ranging from a single strand of seven wires, where a degree of rigidity is desired, to seven strands of 19 wires each, where a maximum of flexibility is demanded. Sizes range from $^1/_{32}$-in. to $^1/_4$-in. diameter.

The results are stated to be not only a considerable weight-saving through elimination of the compensating equipment, but more satisfactory and efficient handling of the plane by the assurance of constant tension. The development has removed the necessity for extreme rigging tensions, which in many cases increase the friction losses in the system to a point where actual control of the plane imposes pilot fatigue more rapidly than is justifiable. American Steel & Wire Company, Cleveland.

Industrial Motion Picture About Copper-Base Alloys

Golden Horizons is a recently released industrial motion picture film in color, with narration and sound, entirely written, produced, and acted by Ampco employees. The 16-mm. film shows the development of copper-base alloys from the first discovery of copper by primitive man. The alloying of bronze, and its growing importance, are interestingly portrayed.

The film was produced for showing before schools, engineering and technical societies, and similar groups interested in metals. It touches briefly on the place of Ampco Metal in the metallurgic field and shows the importance of controlled supervision of alloying. Ampco Metal, Inc., Milwaukee.

Improved Fog-Dispersal Apparatus

The performance of a new type of burner for the dispersal of fog on airfields, using Diesel fuel oil instead of more expensive low-octane gasoline, was demonstrated at the Naval Auxiliary Air Station at Arcata, Calif., to show its utility for the Army and Navy and commercial air lines. In addition to burning cheaper fuel, the new system represents several other improvements over earlier equipment that was developed largely in England. The English subsidiary of the manufacturer was responsible for the development and construction of one of the early British burners. The B & W system was developed in this country.

It is reported that the burners may be installed with a minimum of disturbance to the existing airfield and a minimum of obstruction to aircraft operating on the field. Instantaneous combustion or rapid stopping of burner operation can be achieved, since the burners are ignited electrically from the control tower. The ignited fuel burns with a bushy flame of intense heat and gives off a minimum of smoke while in actual operation, or in starting or shutting down.

Another important difference between the B & W system and earlier burners is that the American development atomizes rather than vaporizes the fuel to prepare it for proper combustion. Drawing on a large background of experience in the development of oil burners for Navy and maritime boilers, the company carried on careful experiments and developed an atomizing nozzle that operates equally well

UNITED AIR LINES

PAA

AMERICAN AIRLINES

CHICAGO AND SOUTHERN AIR LINES

NATIONAL AIRLINES

PCA THE CAPITAL AIRLINE

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CHAMPION SPARK PLUGS

serve these leading airlines

TACA

DELTA AIR LINES

CONTINENTAL AIR LINES

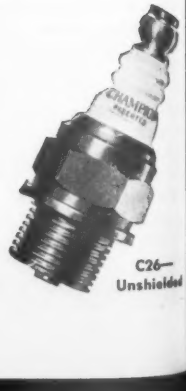
NORTHEAST AIRLINES

WESTERN AIR LINES

C34S—Shielded

The rapid and growing acceptance of Champion Ceramic Aircraft Spark Plugs by leading airlines of the nation follows closely their ever-growing use by our air forces up to the day of final Victory. Today Champions for every aircraft engine offer the maximum in performance and dependability. Champion Spark Plug Company, Toledo 1, Ohio.

USE CHAMPIONS AND FLY WITH CONFIDENCE



C26—Unshielded

VICTORY LOAN

They Finished Their Job—
Let's Finish Ours

with Diesel oil or higher grades of fuel, less atomizing pressure being required as the grade of fuel is improved. When Diesel fuel oil is forced through the nozzle at pressures of 1,000 to 1,500 lbs. per sq.in. the oil burns with a clear flame. Since no preheating or vaporizing is necessary, the flame can be lighted as quickly as the fuel supply valve can be operated. Unlike the vaporizing burners, the system does not require concrete troughs or anchorages, thus simplifying installation problems. The nozzles are small steel tubes and are buried almost flush with the ground, requiring only simple bar guards for protection. By using combinations of various types of nozzles a wide range of thermal capacities can be obtained. The Babcock & Wilcox Company, New York.

Pacing Device for Testing Load Values of Materials

In testing metals, plastics, and woods, many specifications require that the loads be applied at certain and exact speeds. To obtain this control a fully automatic pacing device has been developed.

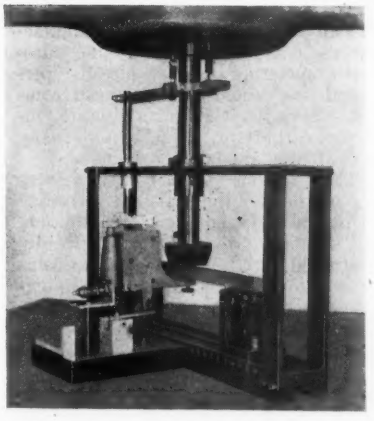
The Southwark Ram Pacer, which attaches to a standard hydraulic testing machine, gives control over the crosshead movement at eight preset speeds, 0.01, 0.02, 0.05, 0.1, 0.2, 0.4, 0.5, and 1.0 in. per min. These speeds are obtained by gear changes on the synchronous motor drive unit. This unit is attached to the fixed frame of the machine while the dial portion of the apparatus is attached to the moving crosshead. The pointer sprocket wheel and the sprocket wheel on the drive unit are connected by an endless weighted chain. With the gear selected for a certain speed, the hydraulic valve of the testing machine is opened until the loading head rises to a point where the dial pointer stands still. This means that the pointer sprocket and the motor-driven sprocket below are moving at exactly the same speed. They counteract each other and the adjustment is simply made.

The Ram Pacer is a combination tool since it can also be used as a deflectometer. The dial is divided into two hundred graduations of 0.001 in. each, and if the synchronous motor is not turned on the dial will indicate the deflection of a specimen under test. The Baldwin Locomotive Works.

Combination Flexure Tool and Deflectometer

A combination flexure tool and deflectometer has been developed for testing molded plastics, plastic laminates, and woods. The instrument fits any testing machine, determining bending qualities of the materials in accordance with the latest Federal specifications and those of the A.S.T.M.

The deflectometer measures the deflection from the center of the specimen and conveys this to an autographic stress-strain recorder which gives the load-deflection curve. One of the important features of this instrument permits the operator to adjust the magnification of the deflection in multiples of 5, 10, 20, 50, 100, and 200 times. The high magnification ratio is used for extremely stiff and brittle materials that deform only slightly before breaking. The deflection, therefore, is measured in terms of thousandths of an inch. The low magnification permits recording large deflections that may be as much as 2 in. with highly flexible materials.



Baldwin Locomotive Works' flexure tool and deflectometer.

In order to obtain tension, compression, and flexure characteristics of the various plastic materials under extreme temperature conditions, the instrument has been designed to fit inside a cabinet in which the temperature can be controlled. The deflectometer will operate from $-70°$ to $+170°$F. Since a certain ratio must be maintained between the length and thickness of the specimen under test, the span is adjustable. The loading nose is guided so that it will travel in a true straight line. The Baldwin Locomotive Works.

Portable, Air-Cooled Generating Set

Designed in cooperation with the Air Technical Service Command, the Bardco portable electric power plant provides electric power for routine and special tests of control motors and other electrical units, as well as for small-tool operation, use of trouble lights and similar equipment. The Model GD15C24 delivers 15 kw., 28½ volts, 528 amp. d.c. from two A.A.F. type R-1 aircraft generators. The generators are driven by a 4-cylinder, air-cooled, 68-hp. Continental aircraft engine, through a step-up gear train.

The adaptation of the aircraft engine is one of the features of this power unit. Forced air cooling for the engine and generators is provided by a gear-driven blower that circulates air through ducts and baffles around the engine cylinders. A specially designed blower element and wind box was developed to convert an air-cooled aircraft engine into a stationary-type unit. Numerous engine modifications were necessary, including the use of Stellite exhaust valves and special piston rings. The carburetor was altered; an oil tank replaced the oil sump; one magneto and a set of spark plugs were removed and a fuel pump and governor-drive assembly was installed on the pad from which the magneto was taken. These and other modifications were made so that the engine could operate on the 100-octane gasoline and SAE 60 lubricating oil used by large aircraft engines, and thus eliminate the need for special fuel and oil supplies. A flyball type governor maintains constant engine speed of 2,400 r.p.m. at full load.

The self-contained power plant is enclosed in a 24S-T aluminum alloy housing. It is mounted on a three-wheel dolly to facilitate easy ground movement, and a retractable towing tongue permits hauling by tractor or other powered vehicle. Overall dimensions are: height, 44 in.; width, 37 in.; length, 72 in. Height includes skid unit, but without dolly mounting. Wheels are removed and stowed when the plant is to be transported by aircraft.

Both R-1 generators run at 6,000 r.p.m. This speed is attained through specially designed gear boxes that step up the 2,400-r.p.m. engine speed. The fan take-off runs at 5,250 r.p.m. A special 3,600-r.p.m. take-off is provided for use with a 2-pole alternator that can be added to the unit. Power-cable terminals are provided, making 7½ kw. available for each of the two circuits, with a 30-min. overload capacity of 9½ kw. for each circuit. Two 20-amp. receptacles are mounted on the front of the control panel for use of small power tools or trouble lights. The unit carries its own starting batteries. Starting, stopping, and idling can be controlled electrically by a switch on the control panel. All electrical controls are located on the switch panel board. Operators can run either generator or both, making the selection through the board. Bardco Manufacturing & Sales Company, Los Angeles.

Drill Press Feed

A new "stepless-range" power feed is designed for use on drill presses, milling machines, surface grinders, etc. It is powered by an air motor and operates on any air pressure up to 160 lbs., delivering a power thrust approximately five times the operating air-line pressure. Feeding rate can be adjusted to fit the needs of stock or tool. Simple adjustment of the two throttle valves permits unlimited variation of feed and retraction speed in a stepless range. Advance may be so slow as to be barely discernible, the return as fast as desired.

A smooth, steady feed, without whip, jump, or backlash, is made possible by the use of the Hydro-Check, a hydraulic resistance unit. The Hydro-Check serves to counteract the natural "bounce" and "springiness" of air and provides a constantly maintained feed-

ing rate regardless of fluctuations in stock hardness. This unit may be used effectively in drilling operations to "check" the feed at the break-through, or may be set to provide a momentary "check" at the bottom of the cutting stroke in blind hole drilling, for greater surface smoothness. Not included as standard equipment, the Hydro-Check is available in a range of six sizes to meet various stroke requirements.

The feeds are made in two sizes: Model DF-60, using a 6-in.-stroke air motor, which gives up to one revolution of the pinion shaft, and Model DF-90, using a 9-in.-stroke air motor, which will give up to one and one-half revolutions of the pinion shaft. Standard equipment includes air pressure regulator, gage, oiler, filter, hose, fittings, and quick coupler. The Bellows Company, Akron, Ohio.

Direct Fuel-Injection Development

Details of the Bendix-Stromberg direct fuel-injection system have been disclosed with permission of the Army Air Forces. Flight tests ranging from tropical climates to Alaska have demonstrated that the new fuel system facilitates engine starting with less warm-up time; achieves faster rate of climb from ground level to high altitudes, improves acceleration, cooling, and engine operation in normal and emergency power ranges; stabilizes operations at lean fuel mixtures; and reduces fuel consumption.

To obtain the accurate control of fuel-air measurement, the manufacturer's engineers adapted the automatic metering devices already perfected and tested in widespread combat use on the company's aircraft "injection carburetor," which equips many of the fighter and bomber engines.

These fuel-air master control devices not only meter the fuel feed according to the rate of engine air consumption, but they also provide for automatically controlled variation of fuel-air ratios as desired for different conditions of engine operation, including automatic mixture enrichment for high power requirements.

On the B-29 engines, two small, compact injection pumps, each synchronized with the main engine-drive shafts, accurately divide fuel into equal parts and pump it at high pressure into individual engine cylinders via airtight stainless-steel lines. Fuel metered by the master control is injected directly into the engine cylinders at pressures ranging from 500 lbs. to 2,500 lbs. per sq.in. This increase in pressure has been made possible by selection of new steel alloys and precision machining of plungers to tolerances of ten millionths of an inch, and through newly simplified production and gaging techniques. All assembly operations on the fuel pumps are performed in air-conditioned rooms under constant temperature to insure pump performance accuracy. The only lubrication needed by the plungers is the fuel that passes through them. Bendix Aviation Corporation.

Tube Flaring Tool from Carbide Lathe Center Tip

The idea of using Carboloy lathe center inserts as tube flaring tools is reported to multiply tool life substantially by comparison with the longevity obtained when conventional flaring tools, made from steel, are used.

The job to which these cemented carbide tipped tools are applied consists of flaring the ends of 1/4, 5/16, 3/8, 1/2, 5/8, and 3/4 in. I D, 24S-T, and 14S-T aluminum tubing on a production basis. The machine employed for this purpose is a Leonard Precision Flaring Machine. Speed range of the machine is between 350 and 1,000 r.p.m. It was found that the high end of the range gave the best results.

The flaring tool used in the machine is made by brazing a stock Carboloy C-6 lathe center tip of solid cemented carbide to a tapered steel shank having a special taper to fit the machine. The lathe center insert is 9/16 in. o.d. This is large enough so that all the work done during the flaring operation is taken by the carbide and none by the softer steel shank.

It is estimated that a high-speed steel flaring tool originally used on this job produced about 100 tubes before wearing out. The improvised Carboloy flaring tools turn out at least 1,000 pieces each before wear becomes pronounced and the tip of the tool has to be replaced or reground. In addition to the saving in tool cost and the more continuous machine operation, the longer runs now obtained also mean greater consistency of work turned out, while pieces produced per hour have been raised approximately 35 per cent through the elimination of "down time" for tool changes. Flaring tools for all other tube sizes up to 1 1/2 in. are now being tipped with cemented carbide. Carboloy Company, Inc., Detroit.

Aircraft Radio Receiver

A new crystal controlled, lightweight aircraft communication receiver will soon be available. Using the Collins Autotune for selecting the channel of operation, the receiver offers ten different preselected frequencies for reception anywhere within the range of 2.4 to 18 megacycles. The maximum time required for the Autotune to change channels is 2 sec. Designed for commercial transport and executive planes, it weighs less than 20 lbs. The receiver operates from a 24-volt d.c. source, with a 12-volt model optional, and will be known as the company's 51K-1 aircraft receiver. Collins Radio Company, Cedar Rapids, Iowa.

Postwar Private Airplane

The new model Skyranger is reported to be greatly improved in range, rate of climb, general performance, and passenger comfort. Changes and refinements were planned by the manufacturer's staff after they completed the engineer-

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ing work on the CG 4A gliders for the A.A.F., although no actual retooling was done. When V-J Day came unexpectedly, about 75 per cent of the former tooling was ready and waiting.

Powered by an 85-hp. Continental horizontally opposed type engine, the craft is expected to cruise at 105 m.p.h. with a top speed of slightly over 115 m.p.h. Cruising range is 700 miles. This two-place side-by-side plane is designed especially for cross-country flying. Upholstering, carpeting, seats, and the arrangement of instruments are planned for utility and convenience. An extra large baggage compartment is provided.

The Skyranger's construction and framework are similar to those of larger planes, although the dimensions and size place it in the so-called light-plane field. The entire tail group is of welded steel-tube construction. The leading edge of the wings has a sheet of duralumin which extends to the main spar. Equipment includes starter, battery, generator, and lights; dual controls; two-position propeller; trim tabs; and wing slots. The plane has a wing span of 34 ft., length 21 ft. 5 in., and height of 8 ft. Weight empty with standard equipment is 980 lbs., and gross weight is 1,450 lbs. Service ceiling is 14,000 ft. and the landing speed is 38 m.p.h. Commonwealth Aircraft, Inc., Kansas City, Mo.

Voyager 150

Deliveries will soon begin on a new, faster, and more powerful Stinson four-place personal airplane. The plane, known as the Voyager 150, succeeds the Voyager 125 and will sell for $5,000. It is powered by a Franklin 150-hp. engine and will cruise at 125 m.p.h. over a 500-mile range. Its maximum speed will be 133 m.p.h. and its rate of climb 770 ft. per min. Service ceiling of this high-wing plane will be 14,000 ft., its take-off at sea level 550 ft., and its landing roll 230 ft. The plane weighs 1,206 lbs. empty; its useful load is 944 lbs.

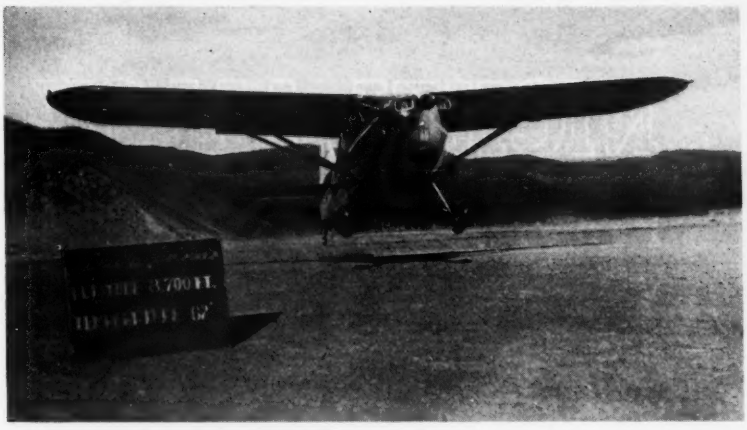
The Voyager 150 will be equipped with a new, all-metal tail design to increase maneuverability. Wing slots make the plane spin-resistant and improved brakes provide greater landing safety. Consolidated Vultee Aircraft Corporation.

Electric Stabilizer Actuator

An electric motor-operated screw-jack actuator has been developed for raising and lowering the horizontal stabilizer surfaces of large aircraft. Until recently, the balancing of a plane on its vertical axis has been accomplished through the use of movable trim tabs on the trailing edges of elevator surfaces, which required complex cable adjustments between the tabs and the pilot's compartment. As aircraft became larger the physical effort to make the frequent adjustments also became a factor.

With the screw-jack actuator, the "fixed" stabilizer surfaces are now raised or lowered, thus eliminating the need for trim tabs on the elevator surfaces.

One actuator is required and a single switch convenient to the pilot raises or lowers the stabilizer at the rate of $^{1}/_{8}$ in. per sec. A total of 11 in. of movement is provided. Loads of up to 16,500 lbs. in one direction and 8,000 lbs. in the other are permissible under maximum load conditions. Total weight of the complete unit, including the $1^{1}/_{4}$-hp., 28-volt motor, gear box, and drive screw is 22 lbs. Electrical Engineering and Manufacturing Corporation, Los Angeles.



The Stinson Voyager 150 takes off from the Creede Airport near the Continental Divide.

Portable Flashing Beacon

For identification signalling at airports, a new lightweight, portable flashing beacon produces high intensity, short-duration, intermittent light flashes. The beacon operates from 110 volts d.c. or a.c., and utilizes a vibrator power supply, for converting to 2,000-volt d.c. to produce the flashing light. The same equipment has been designed also to operate from a 6-, 12-, or 24-volt storage battery. All connections are made with waterproof plugs, and the carrying case itself is waterproofed. The beacon lamp may be mounted separately on a pole if desired.

The unit weighs less and requires less power than a stationary rotating beacon. The light is said to be visible under normal operating conditions for at least 20 miles at night. It produces 30,000,000 candle power and is easily visible in daylight for a considerable distance.

A novel use for the lamp has been to direct it toward cloud banks overhead, where it produces a definite reading on a reflection caught by a light meter. Gaging the time between the release of the light flicker and the reflected reading on the meter gives an accurate check on cloud-bank heights. Electronic Laboratories, Indianapolis.

Radar Camera

Details of a special camera of advanced design for use in photographing radar images have been announced. This camera can be used with every type of air-borne and shipboard radar. It also is expected to be adapted for use with ground types.

The automatic radar recording camera consists of five units: camera, magazine, beamsplitter, adapter casting, and control box. The complete camera installation is connected with the radar circuit and the camera itself is mounted atop the radar's oscilloscope. The unit is so arranged that the operator sitting in front of the radar scope can observe the luminous picture of the terrain, while simultaneously the camera photographs it for continuous, permanent record.

Operation of the camera is fully automatic. It can be set at the beginning of a mission or a job and need only be adjusted if a change in the rate of exposure is desired.

In military applications, the camera provides a complete record of the airplane's flight to and from the target and its position at the instant of bomb release. It is also an aid to reconnaissance, used to give a photographic record of the radar scope image or, rather, a complete radar map of the territory. These are only two of many military applications.

Commercially, the unit will be used principally as a recording camera. Radar-record photography can be applied to give radar maps of worldwide air-line routes and as an aid in determining safe navigational paths. Further, the camera and the magazine proper can be used in conjunction with various specialized adaptations for installation in a plane to photograph the performance record of a group of instruments in flight. In laboratories, the camera can photograph all the minute phenomena illustrated on oscillographs and other instruments, eliminating dependence on visual examination alone.

For aircraft use, the unit can operate at all altitudes between sea level and 35,000 ft., as well as at extremes of temperature. This feature is important also in connection with its use as a

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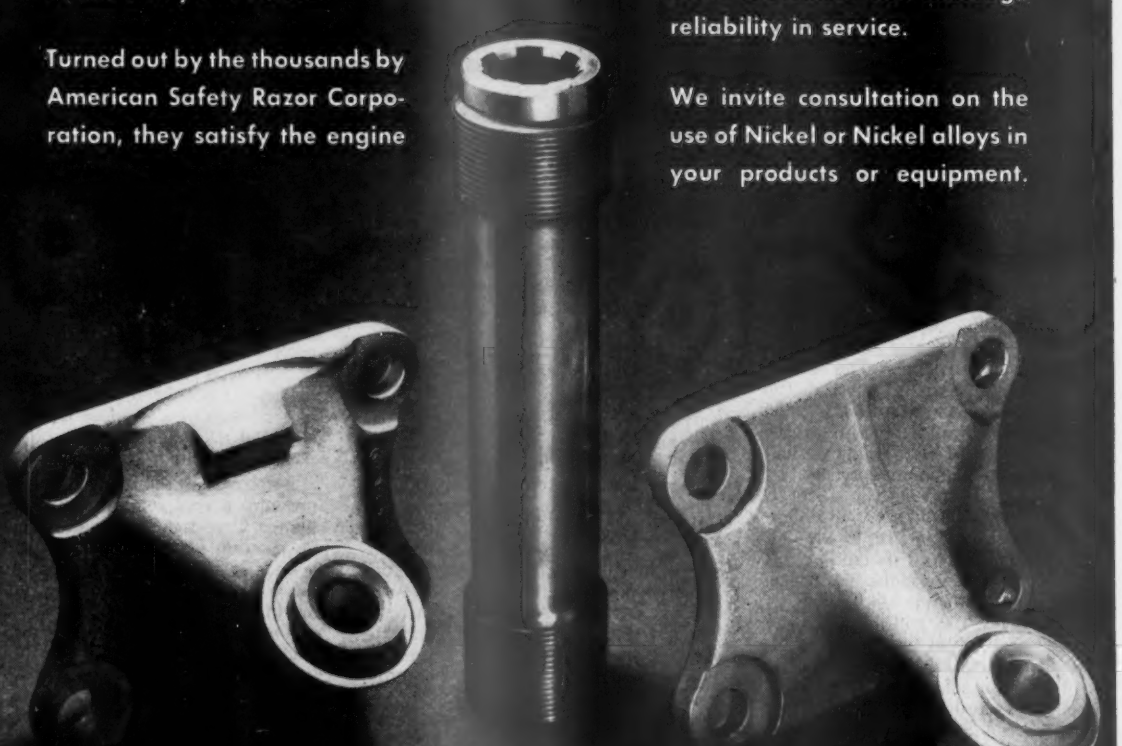
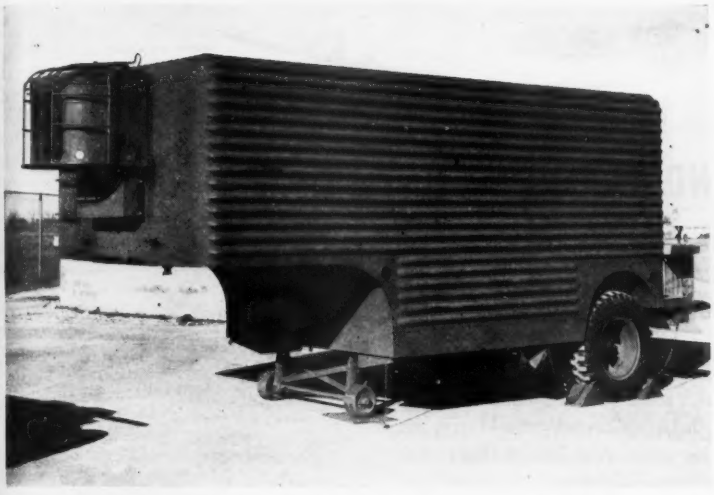


THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.



This experimental refrigerated semitrailer, designed by aeronautical engineers and constructed of the same lightweight aluminum alloys used in aircraft, weighs only half as much as the standard refrigerated trailer used by U.S. Army Quartermaster Corps. It was built for the Army by Fairchild Engine and Airplane Corporation. Grilled box at upper left houses the refrigerator unit.

laboratory camera in the testing of new and complex instruments. Fairchild Camera & Instrument Corporation.

Aircraft Techniques and Facilities Applied to Commercial Products

Aeronautical principles have been followed in the designing of an experimental refrigerated trailer for the Army. Faced with the problem of cutting in half the weight of its standard refrigerated trailer, the U.S. Army Quartermaster Corps asked an aircraft manufacturing company to carry out the work. Intended primarily for transporting frozen meat and C-rations, the refrigerated semitrailer developed is of all-aluminum construction. It weighs only 7,118 lbs. but has virtually the same capacity as the 14,700-lb. refrigerated trailer now used as standard equipment by the Army. The weight reduction of 51 per cent was accomplished by using high-strength aluminum alloys of the type used in airplanes, installing a lighter refrigerating unit, and redesigning the trailer in such a way that every part contributes to its structural strength. Fairchild Engine and Airplane Corporation.

Tungsten-Carbide Gage Blocks

Tungsten-carbide gage blocks are now being manufactured in sets of 35 pieces ranging in size from 0.001 in. to 4.00 in. These gage blocks are said to have a wear resistance at least 100 times greater than that of steel gage blocks, and 98 times greater than chrome-plated gage blocks. They are reported to have superior wringing qualities and to be corrosion-proof. Fonda Gage Company, Stamford, Conn.

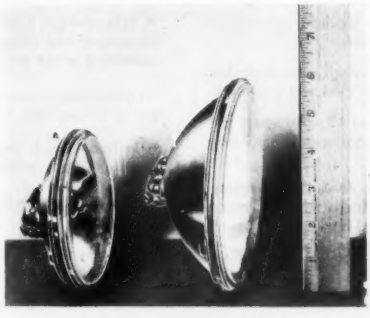
Landing Lamps for Private Aircraft

Two small landing lamps provide private peacetime aircraft with suitable "eyes" for night flying. The smaller lamp has been designated as G-E Landing Lamp No. 4509; the larger as No. 4537.

Each is an all-glass hermetically sealed and self-reflecting unit similar in principle to that of sealed-beam headlamps developed for modern automobiles. The cover glass or "face" of each lamp is clear glass. Each unit is rated at 100 watts.

The smaller lamp is only $4^1/_2$ in. in diameter, produces a maximum beam rated at approximately 100,000 candle power and is intended for use on relatively small personal aircraft of the single and two-seater type. The larger lamp, $5^3/_4$ in. in diameter, produces a maximum beam rated at approximately 200,000 candle power and is designed for use on cabin-type planes seating four to eight passengers. Cover glass of this unit has an almost flat surface conducive to use in retractable landing-light gear.

Recent tests of the landing lamps indicate satisfactory performance when they are used in pairs. The Civil Aeronautics Administration has yet to establish final specifications for them. General Electric Company, Lamp Department.



New General Electric landing lamps for private aircraft.

All-Metal "Swift"

Production of the Swift, an all-metal personal airplane, is now under way. The wing is of the segmental type, semi-monocoque construction, consisting of center section, outer panels, tips, slats, ailerons, and flaps. All components are easily detached for repair or replacement.

The center section is fixed to the fuselage through the main spar and the rear spar attachments. Contained in the center section are landing-gear wheel wells and gasoline tanks. Gear tread of 9 ft. 9 in. affords gear retraction to wells outside the cabin. Gasoline tanks of 15 gal. each are fitted in center-section rib apertures. Gasoline feeds into a common trap on the airplane center line, affecting constant lateral trim. Outer wing panels are attached to the center section by three bolts—two at the main spar and one at the rear spar. Outer panel skins are beaded for additional stiffness without increasing the weight.

Wing tips and slats are attached to the outer wing panels by screws for easy maintenance. Wing tips are detached by removing 20 screws and the slats by eight screws. Complete wing span is 352 in. Aggregate span of the tips and slats is 120 in. All-metal flaps and ailerons of the slotted type are statically and dynamically balanced.

The fuselage is of conventional semi-monocoque metal construction, with bulkheads, frames, and longerons comprising the fuselage shell. Enclosure for the cabin is of the sliding hatch type. Easy access to the cabin is at either side through sliding panels that disappear into the fuselage walls. The entire empennage is of monospar structure with elevators of the "Frise" type. Leading-edge ribs are formed with blanked sheet skin riveted to ribs and spar. Trailing edges are formed strips. The left elevator has a trim tab fastened to an auxiliary spar forward of the trailing-edge section.

A hydraulic system provides rapid actuation of the landing gear and flaps. This system is designed to lower or retract the flaps and gear simultaneously or individually with a minimum of pilot effort. All operations are positive with down and up locks for the gear. Flaps may be stopped in any intermediate position between "no flaps" and "full flaps." Should a hydraulic system failure occur, the gear may be easily lowered to a "down-locked" position by the use of the mechanical "emergency pulldown" linkage.

Landing shock is absorbed through full-sized oleo spring struts that have a $3^1/_2$-in. travel. Shear-web-type nose ribs are used in the landing-gear attachment area forward of the main center-section spar, with two auxiliary shear beams between two ribs. These members form a torque box for the attachment of the landing gear.

The Swift is powered by either the 4-cylinder, 85-hp. Continental or the 6-cylinder, 125-hp. Continental engine. Each engine is available with either carburetion or fuel injection. Starter,

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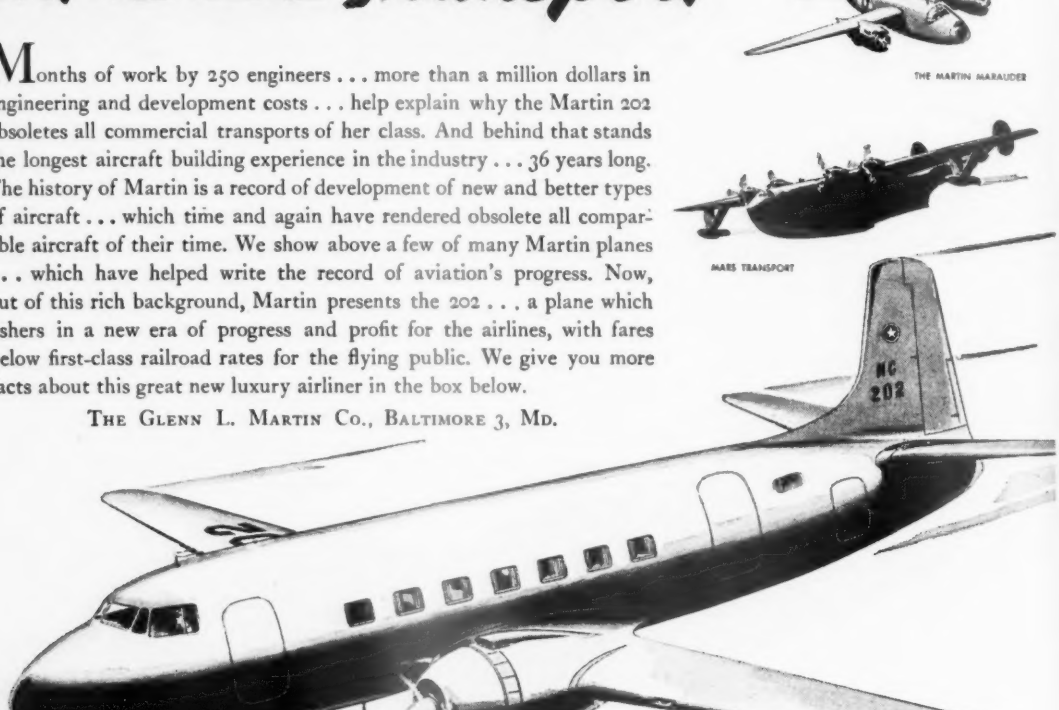

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- Will utilize every new electronic device, including radar, to permit all-weather flying.
- Embodies such improvements as reversible-pitch propellers, heat anti-icing, laminar flow wings, tricycle landing gear.
- Flexible Mareng fuel cells cut maintenance cost and contribute to safety.
- Equipment is located below floor, easily accessible for servicing through exterior hatches.

- The Martin 202 is engineered specifically to meet Air Transport Association specifications. Not just designed for the airline but by the airline—custom-built by Martin—to the most exacting standards of the air traveler.

generator, and two fuel pumps are supplied. Engines are attached to the engine mount, using rubber shock units provided by the engine manufacturer. The engine mount is of welded steel-tube construction and attached to the fuselage at four points. The cowling is made in two parts, the top half being removable by loosening two Dzus fasteners and lifting the handles on the front of the cowl. The lower cowl is attached to the fuselage by four bolts that can be easily removed.

Cabin width of 42 in. permits side-by-side seating for two occupants. Seats and the full one-piece back are cushioned by foam-rubber material. A stepping block is located between the seats, preventing soiling the seats on entering. Upholstery is leather, and an ash tray and map pocket are provided on each side of the fuselage near the instrument panel. All exposed metal is finished with "flox." The cabin is insulated with soundproofing more than $^1/_2$-in. thick. This insulation covers the fire wall, entire floor, and the side panels from the fire wall to the aft end of the baggage compartment. Cabin floor is covered by a felt rug.

The standard instrument panel, located in the center of the cabin, is removable as one unit. Supplementary instruments can be added easily in their respective apertures on the stamped metal panel blank. A plastic panel mounted over the blank eliminates glare on the metal surface. When no radio is installed, a plate is provided over the aperture on the left side of the panel to match the glove compartment on the right side.

It is reported that with a head wind of about 12 m.p.h. the Swift can take off in 550 ft. Its cruising speed is 125 m.p.h. and its time range is 6 hours. Globe Aircraft Corporation.

Polyvinyl Chloride Products

A group of polyvinyl chloride products recently developed is stated to have a great variety of aeronautical applications. The plasticized polyvinyl chloride resins can be applied to fabrics, metals, or stiff plastic board, all widely used in aeronautical applications. Special cements have been developed for attachment of the material to metals or woods.

Made in any color, and embossed to meet specific requirements, the material is reported to be unaffected by sunlight, acids, alkalis, petroleum fractions, body acids, aging and salt water. Color is carried to the full depth of the material, eliminating the necessity of refinishing. Special production methods make it possible to create special finishes, including special pyramid designs.

Applications of the material on airplanes include access-door covering; arm-rest covers, baggage compartments, buffet-counter tops, buffet-section floor coverings; bulkhead coverings; cockpit floors; companionway-wall coverings; heater-duct covering, hostess-seat covering, cockpit upholstery, lavatory floors, lid and seat backs, magazine racks, rug tie-down plate covers, seat gussets, seat kick plates, and side panels below windows. The B. F. Goodrich Company.

"Canning" Method for Storing Material

A new contract for Goodyear Aircraft Corporation which calls for the "canning" of U.S. Army tanks was signed after a period of negotiation between company officials and Army representatives. Preliminary work on the project is already under way to facilitate long-term storage of combat equipment from the recent war.

Each piece of equipment is placed in a large aluminum or steel box and hermetically sealed by welding or heavy soldering. Packaged in this manner, tanks and other war material can be stored in the open, free from danger of deterioration, and with storage costs reduced to a minimum. Customary expense of warehousing, oil, lubricants, and inspection will practically be eliminated.

With the number of military vehicles and other war equipment running into thousands of units, this new storage method may develop into a project of great size, employing large numbers of people throughout the nation. Of especial significance is the fact that much of this packaging will be done with aluminum. Goodyear Aircraft Corporation.

Fast-Climbing Navy Fighter

Designed for operations from either land bases or carriers, the Goodyear-built F2G Navy fighter is reported to have a range of 2,500 miles. Maximum speed is 428 m.p.h. at 16,500 ft. without water injection and 450 m.p.h. at the same altitude with the water injection system in use.

Like the Corsair, the F2G is a single seat, single-engined, inverted-gull-wing monoplane. The plane has the Pratt & Whitney new Wasp Major R4360-4, 28-cylinder engine, with a 3,000 hp. military rating which develops 3,650 hp. or more in combat. The engine drives a four-bladed Hamilton-Standard Super-Hydromatic propeller. Wing span of the new plane is the same as the Corsair, 41 ft.; its overall length is 33 ft. 9 in., and its overall height is 16 ft. 1 in.

In addition to carrying six 0.50-cal. machine guns, the F2G carries eight aircraft rockets mounted under the wings and two 1,000-lb. bombs attached to pylons beneath the main beam structure. Rockets or drop fuel tanks may be substituted for bombs on the two pylons.

The plane is equipped with specially designed vertical tail surfaces, including an automatic auxiliary rudder for greater stability and control. Another feature is Goodyear's free-blown bubble canopy, which is reported to give 360° vision and adequate overturn protection. Other features include self-sealing wing tanks for greater combat radius and a new console-type cockpit arrangement with increased armor protection. The initial rate of climb is stated to be 7,000 ft. per min. The Goodyear Tire & Rubber Company.

Airplane Device Simplifies Piloting

A "3-in-1" pilot's control has been patented and will soon be manufactured for any type aircraft, commercial, private, or military. According to the announcement, the new development, called the "Elme," simplifies flying and airplane manufacture. The unit comprises a substantially vertical shaft, the rotation of which controls the operation of the rudder or rudders, and a substantially horizontal shaft mounted on the vertical shaft for both reciprocation as well as rotation, to control respectively the operation of the elevators and ailerons. The horizontal shaft is capable of three distinct movements: (1) a swinging movement in a horizontal plane on the axis of the vertical shaft and which causes the vertical shaft to rotate; (2) a rotary movement about its own axis, and (3) a linear movement along its own axis. Besides being able to operate each of the three controls simultaneously through the wheel, the pilot also operates each control independently of the others.

The private experimental flights testing the 3-in-1 pilot's control were conducted in a small, "side-by-side" commercial plane. After completing the necessary number of flying hours as required by the C.A.A. and having been tested by that Government agency, a demonstrational license was issued. Greater New York Industries, Inc., New York.

Burst-Proof Accumulator

A hydraulic accumulator designed for safety against bursting is announced. It is so designed that when the internal pressure reaches 300 per cent of the rated working pressure, which is well below the bursting point of the shell, the neck of the shell expands and permits the oil to leak out without danger to life or property. It is impossible to disassemble this accumulator until the air is first released. This additional safety feature eliminates danger to a man attempting to disassemble a loaded accumulator. The accumulator is stated to be unusually light in weight and simple in design. The one-piece shell is of uniform thickness and has no welds, joints, or seams. The one-piece fully enclosed synthetic rubber bag has an operating range between −65°F. and +160°F. The accumulator may be assembled or disassembled in the field without tools. Greer Hydraulics, Inc., Brooklyn, N.Y.

New Hollow-Steel Propeller Blade

It is stated that production models of a new hollow-steel propeller blade have passed stringent Army and Navy type tests and that the blades are employed on at least six experimental warplanes under development for the armed forces.

At last

Heli-Coil Inserts for Your Products

...wherever you use TAPPED THREADS!

HELI-COIL Screw Thread Inserts are precision-shaped helical coils of stainless steel or phosphor bronze wire. They are inserted in standard 'NC and 'NF' threads. They have two principal functions: 1. To protect tapped threads against wear and abrasion; 2. To restore worn or stripped tapped threads in any material.

During the war, almost the entire output of Heli-Coil Inserts was allocated to aircraft engine production and maintenance. Now, they are available for your peacetime products! We have no reconversion problem, can therefore promise prompt delivery to help your reconversion.

Think of all the places where YOU can use stronger, more durable tapped threads. Then write today for detailed information.

ENGINEERING REPRESENTATIVES:

DETROIT	NEW ENGLAND	KANSAS CITY	LOS ANGELES
G. C. Brown and A. W. Reader 201 South Pleasant St. Royal Oak, Michigan	Donald McClain 6 Pioneer Circle Manchester, Conn.	Pacific Airmotive 1628 McGee St. Kansas City 8, Mo.	J. S. Wise Room 925 Pacific Mutual Bldg. 523 West 6th St. Los Angeles, Calif.

THE SCREW SYSTEM WITH THE ANTI-FRICTION THREAD LINING

HELI COIL

U. S. and Foreign Patents Issued and Pending

AIRCRAFT SCREW PRODUCTS COMPANY, INC.
47-23 35th STREET • LONG ISLAND CITY 1, N. Y.

Designed for use with new versions of the Hydromatic propeller and the Super-Hydromatic propeller, the blade marks a departure from the customary construction and materials methods followed by the manufacturer for the past 15 years. All previous large-scale production propellers were provided with duralumin blades. The decision to turn to the hollow-steel blade was made several years ago, when it became evident that propellers would continue to increase in size and weight.

The basic blade structure is analogous to that of an airplane wing, having a main structural member in the form of a flattened tube which provides, in effect, two "spars" on which the airfoil shape formed by a thinner outer shell is supported. The outer shell is supported chordwise between the leading and trailing edges and the main spar by a hard sponge-rubber filler.

It is stated that one of the outstanding engineering developments in connection with the hollow-steel blade has been the evolution of a highly efficient and relatively simple blade-retention system. This is achieved by providing bearing races fabricated directly to the shank or butt end of the blade to correspond with similar races fabricated in the hub. Balls are loaded into the raceways at the time of assembly of the blade into the hub.

The lightweight and efficient structure of this hollow-steel blade makes it possible to provide an airfoil section of full width all the way into the propeller hub, thus obviating the need for cuffs or shank fairings. Hamilton Standard Propellers Division, United Aircraft Corporation.

Portable Power Conveyer

To meet present-day needs for flexibility in conveying equipment, a small powered belt conveyer unit is being produced in 10-ft., 5-ft., and 3-ft. lengths. These units can be coupled together to make as long a conveyer system as wanted. They can be placed to form any shape, and will convey on the level, up, or down grade. Two sections will make a 30° turn, three sections a 60° turn, and four sections a 90° turn.

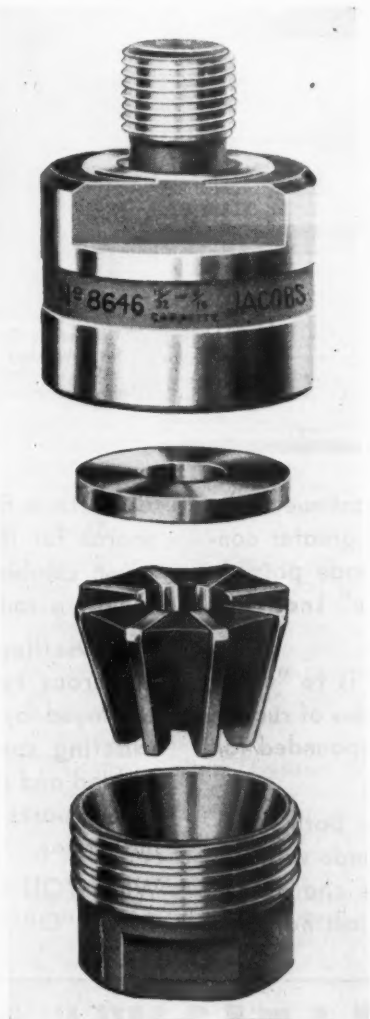
The entire assembly or system can be controlled from the unloading end by a push button. The speed of all units is synchronized. The system can be quickly added to or shortened without any special wiring. No guides are required at any point to keep material being conveyed from jumping or running off the belt. Island Equipment Corporation, New York.

Neoprene Improves Action in New-Type Drill Chuck

A type of heavy-duty drill chuck has been developed in which a tough web of neoprene synthetic rubber is said to keep the jaws in better alignment while permitting one chuck to take a wider range of drill sizes. In this function, the resilient material replaces the flexible spring steel collet shank of the traditional single-purpose type of drill chuck. The rubber is bonded to the steel jaws and passes through anchoring holes in them, a design that makes the collet or inner socket of the chuck a compact, conical unit. The Rubber-Flex Collet, as it has been named, is tightened by a screw mechanism that forces it forward into the smooth funnel-shaped nose of the chuck. As soon as the chuck is loosened, for changing drills, the neoprene web pushes the jaws apart and releases the drill shank.

All working faces of the hardened alloy steel jaws are precision ground after assembly in the neoprene matrix. Because the jaws are always parallel they maintain full-length contact with the drill shank, thus providing adequate gripping area. The design is such that in use the collet is self-tightening, with a toggle-like action.

Versatility and ruggedness of the new type chuck are expected to bring about greater economy and efficiency in large-scale machine-shop production work.



Jacobs Manufacturing Company's heavy-duty drill chuck uses Neoprene synthetic rubber to replace the steel collet shank of the traditional type of drill chuck.

It is stated that twelve of the Rubber-Flex collets and three detachable arbors will handle a range of these operations which would require 300 of the ordinary single-purpose collets.

The models now being produced are for multiple-spindle drilling machines. Plans are also under way for introducing the new collet in portable electric drills and hand drills. The Jacobs Manufacturing Company, Hartford, Conn.

Torque Wrenches

The Jotee and the Joel are two torque wrenches developed originally for light precision assembly on aircraft. The Jotee is a ratchet-type torque wrench, constructed of solid aluminum. Preset at the factory to any torque within a range of 5 to 40 in./lbs., it may be reset in the plant toolroom whenever assembly specifications change. The Joel has the same range as the Jotee and is particularly adaptable to close assembly work. It is made in both the ratcheting and nonratcheting type of tool.

The action of both tools is positive, releasing when the predetermined torque is reached. The tools are also recommended by the manufacturer for working with plastics where damage to materials from overtightening is likely to be high.

Several improvements in the Jomi torque wrench are reported. All moving parts pertaining to the torque-control feature of the wrench now have ball bearings. With this wrench it is unnecessary to compensate for a frictional load. Variance caused by a variable friction load has been eliminated and so has the possibility of overtightening. Once set, the grip automatically breaks when the predetermined torque has been reached without the operator having to depend upon dials, clicks, or taps. The operator instantly sets the tool by turning the guide to the desired micrometer reading on the barrel. The rubber-capped head has been discontinued and in its place is an all-metal head. Both the head and the handle are now made of heat-treated aluminum.

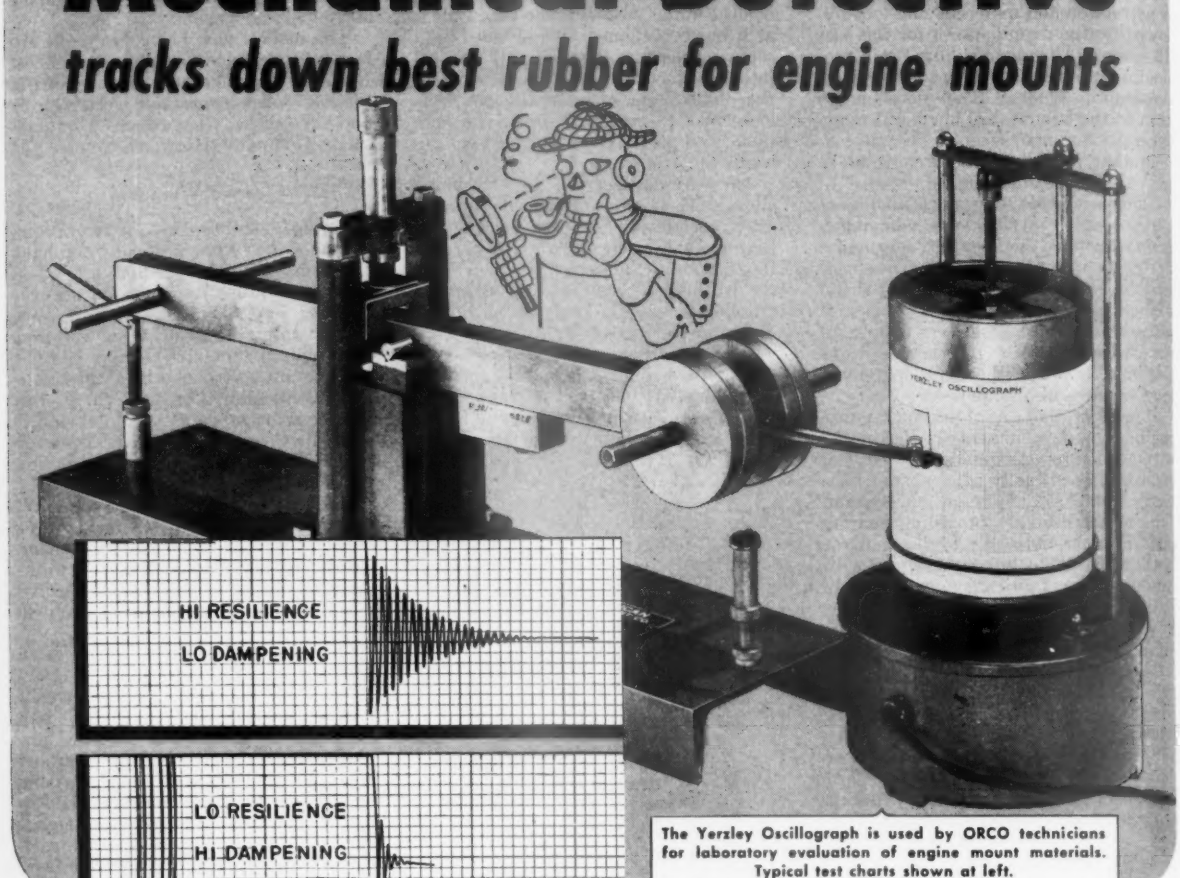
The company is also introducing another wrench, Model 1600. This is an extra large, heavy duty wrench with a torque range from 700 to 1,600 in./lbs., and a $1/2$ in. standard drive. The Model 600, now called Model 750, has a torque range of 100 to 750 in.-lbs. and a $3/8$ in. standard drive. The JO Manufacturing Company, South Gate, Calif.

Anchor-Type Lock Nut

A new anchor-type lock nut is announced for use in sheet-metal installations where it is convenient or necessary to have the nut member held in place during assembly. The construction of this device consists of three parts: the lower half is a "carrier" for the nut and is made of tempered spring steel with a "built-in" lockwasher; the upper half is also made of spring steel and keeps the third part, a plain square nut, contained within the assembly. Two spring ears project from the lower part

Mechanical Detective

tracks down best rubber for engine mounts



The Yerzley Oscillograph is used by ORCO technicians for laboratory evaluation of engine mount materials. Typical test charts shown at left.

SHOCK and VIBRATION continue to be "Engine Enemies No. 1." But greater control of these "enemies" is made possible by a "mechanical detective" known as the Oscillograph.

Function of the Oscillograph is to "track down" the elusive characteristics of rubber and rubber-like materials compounded for engine mount specifications.

Resilience measurements under both static and dynamic conditions are made with the Oscillograph. Determining the characteristics of engine mount materials narrows down to a finer degree of accuracy. The search for the best compound to meet a given combination of conditions becomes almost a routine procedure.

The Oscillograph is an example of the numerous types of modern equipment employed by ORCO technicians to meet exacting specifications for mechanical molded and extruded rubber and synthetic rubber parts and products for diversified industries.

When YOU face a problem in rubber . . . CALL "ORCO."

"ORCO-OPERATION"

BRANCHES: DETROIT • NEW YORK • CHICAGO
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THE OHIO RUBBER COMPANY · WILLOUGHBY, OHIO

and are used to engage the sheet of metal to which the nut is to be attached.

The part to receive the nut must be provided with two $^{5}/_{32}$-in. diametrically opposed holes and spaced a specified distance from the center hole. The anchor-nut assembly is then merely snapped into place by hand, without the use of tools. The nut then "floats" freely with respect to the center hole to allow for alignment of subsequently assembled parts.

The lock nut is credited with several main advantages: (1) It cuts the cost of assembly of the anchor nut to the sheet by eliminating the need for riveting or spot-welding the anchor nut. (2) It is removable. In case of damage to the threads, the new unit can be replaced in seconds, whereas with spot-welded or riveted types considerable time is spent for such repair. (3) It "floats." An important asset to any fastening device is its ability to align itself with the mating or attaching device. (4) It is a lock nut and therefore can be used anywhere where there is vibration, without danger of the screw shaking loose.

The device is available in $^{1}/_{4}$-in. size but other sizes are expected to be on the market in the near future. Kaynar Manufacturing Company, Los Angeles.

Cluster-Type Rocket Launchers

Information about the cluster rocket launchers that gave the P-38L Lightning fire power comparable with a broadside from a destroyer's battery of 5-in. guns has been released from military restrictions. The Lightnings augmented their war accomplishments by utilizing the new explosive missiles to destroy pill-boxes, caves, and underground enemy fortifications.

The rocket-launching device, installed as standard equipment, required no change in the plane's wing. It also was added to hundreds of the fighters already in battle service. An advance over previous launchers used on Allied fighters was a free-flight principle which permitted point-blank firing and assured greater accuracy of aim. The compact mounting of five rockets under each wing gave a greater concentration of fire power when rockets were projected in salvos.

The most recent rocket launcher carried five projectiles. Rockets were hung on zero-type tracks arranged in a pattern that resembled an inverted triangle. Electrical controls for release permitted the pilot to fire two rockets—one from each cluster—simultaneously. Fired in salvos, rockets could be launched in pairs every tenth of a second. In $^{1}/_{2}$ sec. the entire load of 5-in. projectiles could be fired at any enemy target. Lockheed Aircraft Corporation.

Universal Lathe Angle Plate

A universal angle plate for lathe use is designed to take the place of special jigs and fixtures ordinarily required for holding irregularly shaped work that cannot be chucked in the usual manner. Virtually a toolmaker's angle plate mounted on an adjustable base for attachment to the face plate of a lathe, this lathe angle plate together with its accessories makes possible the precision machining of offset inside and outside diameters, bushing and die plates, irregular-shaped castings, and scores of other jobs, without the necessity of special fixtures. The angle plate is L-shaped with side face $5^{1}/_{8}$ in. by 4 in. and bottom face $5^{1}/_{8}$ in. by $5^{3}/_{8}$ in. It is mounted on a base provided with an adjustment screw and ground ways, and is fitted with gage points so that work can be accurately and quickly positioned with size blocks or calipers. A straddle clamp with adjustable set screws is provided to tighten work against the bottom face of the angle plate.

One of the accessories available with the angle plate is a fixture for holding plates. This device, which is particularly useful in machining bushing and die plates, consists of a box-like structure with a T-slot at the bottom for mounting on the angle plate. The side walls of the fixture are provided with holes spaced 1 in. apart, through which undercut clamp pins can be positioned. When a plate is to be clamped in the fixture, the pins are located to fit the dimensions of the plate. Then by tightening the nuts on the back ends of the pins, the plate is drawn securely against the ground surface of the fixture. Once locked in place, the plate can be further positioned by using the adjustment screw on the angle plate, and "Jo" blocks at the gage points if extreme accuracy is desired. This work-holding fixture will hold rectangular, circular, and irregular-shaped plates up to 5 in. in width and 1 in. in thickness. One of the chief advantages of boring die plates by this method instead of with a jig boring machine is that tapered clearance holes can be more easily and accurately machined.

Another accessory available with the angle plate is a large V-block and clamp designed to hold rounds up to 3 in. in diameter. It is attached to the base of the angle plate with T-bolts and can be positioned at any angle to facilitate the machining of eccentrics, diameters at offset angles, off-center holes, multiple-angle holes, etc.

The third available accessory is a special indexing head that is also attached to the angle plate by means of T-bolts. It can be secured in any position on the angle plate and is particularly useful in positioning work for radially spaced machine operations. The indexing head consists of a spindle or hub supported horizontally by a sturdy base. A flange at one end of the spindle is provided with a projecting pin designed to fit into a ring of holes in the base that are spaced at 15° intervals. With this indexing head, facing, boring, turning, etc., can be performed at intervals of 15° or any multiple of 15°. Madco Products, Inc., New York.

"Canning" Surplus Goods for Preservation

The development of aluminum "barriers," some of which "breathe" through a drying agent and others are hermetically sealed, has resulted from experimental contracts with the Ordnance Department of the Army for the preservation of guns. It has been determined that by such methods all sorts of manufactured articles and materials can be stored in the open for many years without rust, corrosion, or deterioration.

By eliminating the necessity for warehousing, this development solved one of the problems confronting those interested in the storage of surplus war material, permitting the storage of "canned materials" in the open on Government reservations or other open spaces owned by private concerns.

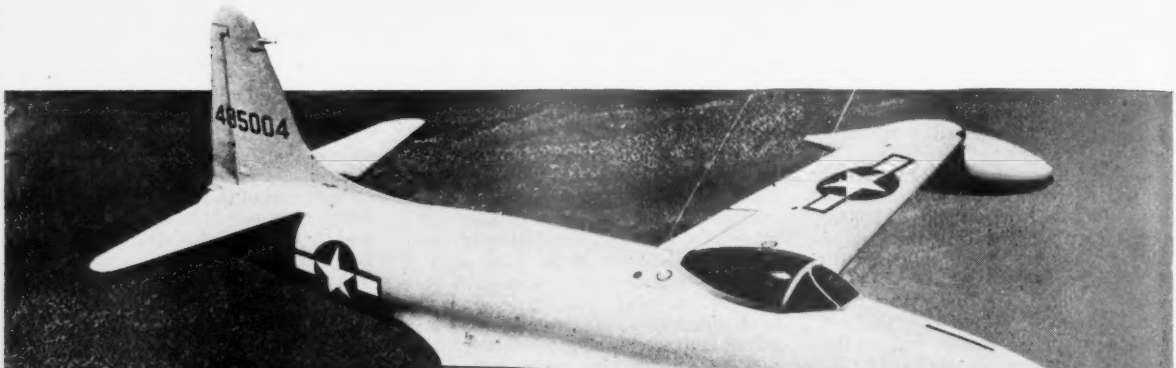
The new scientific "canning" process is expected to be a boon to exporters and importers in the shipping and outdoor storage of valuable stocks. Not only can the contents be protected against any climatic or weather conditions, but a great saving can be effected over extended periods through eliminating warehousing costs, as well as through weight-saving over heavy wood crating, thereby cutting shipping costs. Aluminum is used because of its resistance to corrosion, its lightness of weight, and because surplus stocks and manufacturing potential are available.

One of the most interesting of the Martin devices is called the "balanced pressure barrier." The big can, now being modified to fit field guns, actually "breathes" away moisture. At night and under cloudy conditions, the barrier "inhales" air through a screen of silica gel. In sunlight it "exhales" air through the gel, drying and reactivating the desiccant automatically. Accelerated tests of this process give a promise that the contents can be protected without maintenance for many years.

The "canning" of industrial presses and machinery, engines, motors, instruments, communications equipment, typewriters, office equipment, wire, and all sorts of electrical assemblies and other items in excess of normal consumer needs offers a further opportunity for utilizing aircraft-manufacturing facilities. The Glenn L. Martin Company.

Model 228 Passenger-Cargo Transport

A new passenger-cargo transport plane, specifically designed for use by air lines on routes where passengers are not always at a maximum and where smaller landing fields are a part of a "short-trip" system, has been designated Model 228. In many respects a "little brother" of the Model 202, the Model 228 has a passenger capacity of 26 and a weight of 28,500 lbs. Its fuselage measures 68 ft. 8 in. It is a low-wing, twin-engined monoplane, featuring all-metal construction, full cantilever wing and tail surfaces, semimonocoque fuselage, and fully retractable tricycle-type alighting gear. Wings,



Jet-propelled P-80 "Shooting Star" (U. S. Army Air Forces Photo)

Bullet with Wings

It's an old idea that gave bullet-like speed and climbing power to the jet-propelled airplane.

As a motivating force, the basic principle of jet propulsion dates back hundreds of years—but it took modern skill and ingenuity—it took the finest of materials—to produce a practical jet engine.

Important among these materials are Republic Electric Furnace Steels, including Enduro Stainless Steel. These alloys permit the use of temperatures which would warp or oxidize less resistant materials. They are used, also, to insure safety in the shaft connecting the impeller and turbine.

Thus, Republic Electric Furnace Steels have helped make possible another important development—just as they can be employed to improve quality, increase salability and reduce manufacturing cost of YOUR present and prospective products.

Because they are "targeted" by the close control possible only in electric furnace melting, these steels hit narrow specification marks *every time.* Because they are as CLEAN and SOUND as steel can be made, they insure against hidden inclusions. And because they are *consistently* UNIFORM in physical, chemical, hardenability and performance values, they enable manufacturers to obtain full benefits from mass production methods.

Nothing is too good for your product, if it will make your product better or cut costs. That's just what Republic Electric Furnace Steels have done for others. Let us tell you what they can do for you.

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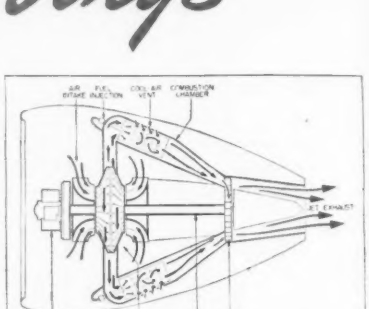


—and what makes it go

Air, as cold as 75° below zero, enters the engine, is compressed by the impeller and whipped into the combustion chamber where fuel burns fiercely. Pressure is increased by the action of the impeller and the combustion increases the temperature to 1500° and higher. The terrific blast thus created spins the turbine at thousands of revolutions per minute, then rushes out the jet exhaust to give forward thrust to the plane.

REPUBLIC
—Leader in the Production of
ELECTRIC FURNACE STEELS
"QUALITY" steels . . . alloy . . . stainless

landing gears, tail surfaces and most of the fuselage are identical and interchangeable with those of the 202.

Model 228 is especially designed to provide a plane that would answer the air-line operators' problem of the "short haul" on low-traffic-density routes. The plane's low operating costs, plus its ability to operate from small fields, provides transportation facilities at the low hourly costs required to show a profit for this type of operation.

Affording all the convenience of larger planes, the interior arrangement provides for a pilot's compartment, with the pilot and copilot seated side-by-side, a luxurious passenger compartment, a large cargo compartment, ample storage space for luggage adjacent to the entrance way, buffet facilities for hot food service, and a spacious lavatory.

The Model 228 is equipped with 1820-type Wright Cyclone engines, capable of 1,425 hp. at take-off. Because of its design and power, it is said that the plane can operate from landing fields that afford less than the 3,500-ft. runways required for the larger 202. It has a minimum turning radius of 60 ft. and lands at approximately 70 m.p.h.

Major consideration was given to ease of maintenance in designing the new plane, with particular attention paid to installation of such equipment as power plants, instruments, radio, and others requiring periodic changes, so that these items can be removed and replaced with a minimum loss of time. Adequate inspection covers have been included in all surfaces and other locations where frequent inspection is required. Wherever practical, left-hand and right-hand assemblies have been designed to be interchangeable.

General dimensions are as follows: span, 92 ft. 9 in.; length, 68 ft. 8 in.; height over tail, 3-point position, 24 ft. $10^1/_2$ in.; maximum fuselage cross section, 9 ft. 8 in.; span of tail, 36 ft. 6 in.; mean aerodynamic chord, 120.2 in. The Glenn L. Martin Company.

Services of M.I.T. Radiation Laboratory Revealed

Most of the radar used by the armed forces had its origin in the Radiation Laboratory of the Massachusetts Institute of Technology, where 3,800 members worked in secrecy on research and development of this equipment. Now the restrictions imposed by military secrecy have been lifted and the story of the Radiation Laboratory has been made available to the public.

Operating its own plant and its own airport at Bedford, Mass., on loan from the Army Air Forces, and with field stations scattered at many points over the United States and both sides of the world, the Radiation Laboratory began in November, 1940, in a few rooms assigned to it at M.I.T. The task assigned to the Radiation Laboratory when it was founded was the development of microwave radar—that is, radar working on higher frequencies than had ever been used before. In addition to research and coordination, the Radiation Laboratory early began to act as its own manufacturer, building small numbers of radar sets of its own design in emergency cases where there was not time for manufacturers to tool up for large-scale production. A single radar set of a type based on the ground and having extremely high power was an important factor in spotting buzz-bombs so that fighters could shoot them down. This same high-power radar was also useful in enabling effective ground control of tactical fighters and bombers.

In the summer of 1942, the Laboratory's "sea-search" radar (the offshoot of the first night-fighter set) was patrolling the Atlantic in United States and British planes. Production sets resulting from it are credited with 50 per cent of the destruction of enemy submarines in the Atlantic.

During 1943, a laboratory branch was established in England, to provide closer liaison with the British on an important radar set using both British and American parts. This British branch was soon closely linked with the U.S. Army in England, and later on the Continent, largely through the efforts of other Radiation Laboratory personnel attached to top commanders as representatives of the office of the Secretary of War, to advise on the operational use of radar.

One of the peacetime commercial uses of radar is the system called G.C.A. (Ground Controlled Approach). The system comprises two complete radar systems. With one, the operators search the zone surrounding the airport by means of radar scopes showing a map-like presentation, directing the air traffic approaching the field into the sector scanned by the second system. This system, a high-precision radar, giving practically continuous information about the plane's position, is used by the final controller to guide the pilot down the glide path. One precision indicator shows the height of the plane and of all ground obstacles along the path, so that the plane can be kept a safe distance from buildings, towers, or hills; the other shows the plane's lateral position with respect to the runway.

Of the five-man operating crew, two at the scopes can select communications channels in all aircraft bands to direct traffic, and the final controller, at indicators showing error in azimuth and elevation from the correct glide path, also has complete radio facilities. Flanking the final controller, two trackers follow the course on the special precision indicators, and supply him with azimuth, elevation, and range data. The control and tracking procedure is easily adjusted to fit the flight characteristics of any aircraft type, fighters, bombers, cargo planes, or commercial air liners being handled equally well.

Teamed with early-warning systems, radar beacons, and other radar sets for the general surveillance of air traffic, G.C.A. can provide widespread ground control of aerial navigation. Such a combination of equipment makes possible the first true all-weather airway, on which flights will operate on schedule with safety, despite weather that may require negotiating the entire journey without sight of the ground. Massachusetts Institute of Technology.

New Parts-Cleaning Machine

A portable type parts-cleaning machine agitates the cleaning fluid by air pressure only. Designed especially for use in automotive and other repair shops, this new Parko unit is intended to remove grease, grime, and carbon from carburetors, fuel pumps, tools, electrical parts, instruments, etc., in a few minutes. No heat is required.

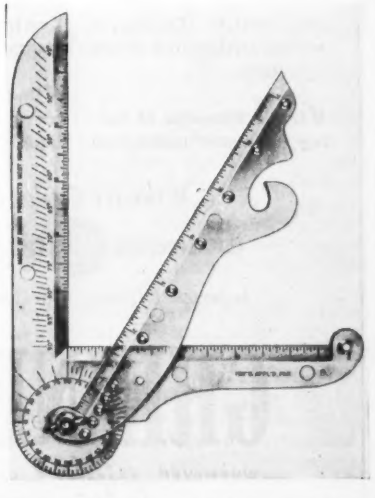
Two systems of cleaning are combined in the one unit. Large parts to be cleaned are placed in the tank and the cleaning solution is agitated by means of air pressure. The air is dispelled from a series of holes in a pipe which runs lengthwise at the bottom of the tank.

Small parts such as screws, washers, etc., are placed in the round basket and soaked in the solution for a few minutes. The basket can be revolved by hand. After the parts have been cleaned, the rack is placed on an attached drainshelf which drains the solution back into the tank for re-use. Parts are then blown dry by means of the air gun and rinsed with water or petroleum spirits.

Tank-Solve, a cleaning solution, was compounded especially for use with this machine. Based on a formula of the nonevaporating type, it is credited with effecting a 50 per cent saving in solution costs because it can be used repeatedly. Park Chemical Company, Detroit.

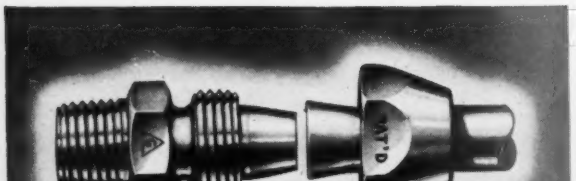
Eight-Purpose Drawing Device

An all-purpose drawing and measuring device is accurately designed and mathematically calibrated to serve as a square, dividers, protractor, triangle, ruler, compass, French curve, and miter. The Parva-graph, made of transparent plastic, consists of two parts: a combination square and a removable miter



Parva Products Company's transparent plastic drawing device.

8090 lbs. pressure... no leaks*



* From Underwriter's Laboratories' Report No. 42C649 ... When ½" steel Superseal fittings, made up with steel tubing, were subjected to pressure tests, no leakage occurred. At 8090 lbs. pressure the steel tubing split at a point away from the fittings.

SUPERSEAL Flared Tube Fittings

provide leakproof joints even under maximum vibration and pressure

Check these other features

✓Long 10° Tapered Cone provides greater seating area for tubing flare.

✓No Shearing Action to injure the tubing at the point of flare when the nut is tightened – instead the tubing is actually strengthened.

✓All Tubing Easily Flared to Superseal's 10° angle... production flaring of welded steel tubing in one operation.

✓Inside Diameter of Tubing uniformly maintained . . . no obstructions at the joint.

✓Tubing Bends can be made close to the fitting.

✓Materials . . . Stocked in steel. Malleable iron, brass, aluminum or alloys on special order.

✓Parkerized and Wax Coated . . . corrosion-resistant.

✓Underwriters Approved for all hazardous gases and liquids.

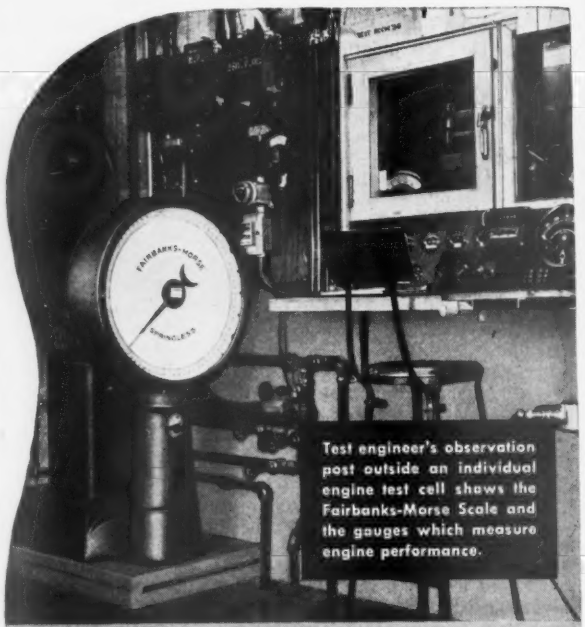
Write for Catalog 3-R

GRINNELL COMPANY INC.

Superseal Division, Providence 1, R. I.

GRINNELL

WHENEVER *piping* IS INVOLVED



Test engineer's observation post outside an individual engine test cell shows the Fairbanks-Morse Scale and the gauges which measure engine performance.

Scales AID PLANE ENGINE TESTING

THERE can be no chances taken with aircraft engines. Before they're mounted, they must be tested for developed power, heat, and gas and oil consumption.

Doing the latter job at Continental Motors is a battery of Fairbanks-Morse Fuel Test Automatic Dial Scales.

Fairbanks-Morse Scales can do an accurate job for you, too. Their dependability and simplicity of design are backed by more than *100 years of scale-building experience.* Fairbanks, Morse & Co., Fairbanks-Morse Bldg., Chicago 5, Illinois.

Fairbanks-Morse

A name worth remembering

Diesel Locomotives • Diesel Engines • Generators
Motors • Pumps • Scales • Magnetos • Stokers
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arm which can be mounted on the square through either of two mounting holes. A wing nut locks the miter arm at any desired position. By varying the position of the miter arm, angles of any degree can be formed, and right-angle triangles can be made with acute angles of any degree desired. By removing the miter arm entirely and using it as a radius, circles can be scribed from 1/2 in. to 14 in. in diameter. The Parvagraph may also be used to square lumber, to scribe a line on a board as a guide for rip-sawing, and to miter a 45° angle off the protractor in three positions. It can be locked in the 45° position by driving a pin into the drawing board through two small holes provided for that purpose in the combination square and miter arm. Parva Products Company, West Haven, Conn.

Circuit Relay

The LMR Series is announced as a standard-type plate circuit relay designed to meet the demand for a high-grade, medium-cost relay in both single- and double-pole contact arrangements. The relay is built in two sizes: single-pole relays are 2 1/4 in. long, 2 3/8 in. high, and 1 3/8 in. wide. Double-pole types are 2 1/4 in. long, 2 3/8 in. high and 2 1/8 in. wide. Mounting dimensions are two tapped holes, 6-32 thread, 1 3/16 in. center to center.

These plate circuit relays are constructed with extra large coils that make them sensitive enough to give good contact pressure at low current values. Standard adjustment is approximately 0.1 watt for the single-pole types and 0.2 watt for the double pole, although lower values can be obtained when necessary. Coils on the LMR (except on special order) are random wound on insulated bobbin, impregnated with baked varnish insulation.

LMR relays are available in six contact arrangements: single-pole, double-throw; single-pole, single-throw, normally open; single-pole, single-throw, normally closed; double-pole, double-throw; double-pole, single-throw, normally open; double-pole, single-throw, normally closed. Potter & Brumfield Manufacturing Company, Inc., Princeton, Ind.

New Method of Determining Iron Content of Aluminum Alloys

A speedy, more accurate method of determining the iron content of aluminum alloys has been introduced. The method is based on the color reaction between iron and orthophenanthroline, a reagent that turns orange when it unites with iron. Besides being faster, the new method is credited with being more accurate—accuracies of ±0.05 per cent are possible—and requiring considerably less skill on the part of the technician, making it practical to assign ordinary laboratory workers to the test. Compared with the 2-hours' testing time needed for the usual method of determining the amount of iron in an aluminum alloy by means of potassium permanganate titration, the new process takes 20 min. and can be employed by almost any laboratory worker.

Aluminum to be tested is dissolved in a dilute solution of hydrochloric acid and a reductant is added. There is an almost complete absence of interfering ions, those which do not appear being eliminated by filtering. The solution, containing an excess of orthophenanthroline, turns orange. The intensity of the color indicates the amount of iron present in the sample of the alloy tested.

Final determination of the proportion of iron present in the alloy is made photometrically. A Coleman Universal Spectrophotometer or other similar instruments may be used. The wave length that produced the maximum absorption was found to be at 4,900 A. Measurement of the light passing through the orange-colored solution and comparison with a standard quickly indicates the amount of iron present in the alloy. Ranger Aircraft Engines Division, Fairchild Engine and Airplane Corporation.

Multi-Scale Monocular

The outstanding feature of a new optical instrument, known as the Multi-Scale Monocular, is that it provides the means to measure and compare small objects with the aid of a highly corrected six-power optical system and six selectable scales, all of which are incorporated in the instrument. Making the instrument especially desirable in the examination of abrasive surfaces, the optical arrangement projects the scale selected in the plane of the object to be observed, without the scale itself being in contact with the surface under observation. The scale desired for a particular measurement can be brought into the field of view by simply turning the outer rim of the eye cap. The circular field of view, having a diameter of 1 in., is automatically in focus when the instrument stands on its base. The scales appear in the field of view as brightly illuminated markings, superimposed upon the surface under examination. Because of its convenient size (height 2 1/2 in., diameter 2 1/4 in.) combined with its relatively light weight (7 oz.) the instrument is adapted to a wide variety of uses, including examination and inspection of textiles, finishes, surfaces, and textures. Since the instrument provides with equal facility means for comparison as well as measurement, its wide versatility makes it useful in a practically unlimited number of fields where inspection, measuring, or comparison is, or should be, done under magnification. Ray Control Company, Pasadena, Calif.

A.C. and D.C. Magnetic Relays

A new line of single- and two-pole a.c. and d.c. magnetic relays for industrial and electronic application is now being produced. The ratings are 10 amp. at 24 volts d.c. and 110 volts a.c.; 5 amp. at 220 volts a.c.; and 1-hp., single-phase, 110 and 220 volts a.c. Contact arrangements are single- and double-pole; normally open, normally closed, and double-throw. Silver-to-silver contacts are used.

The armatures are self-aligning. All wiring terminals are accessible from the front. The single- and two-pole a.c. and d.c. relays have identical bases for interchangeability in mounting. The relays may be mounted either from the front or rear.

All these relays are available in the open type or with sheet steel, general purpose enclosures. R-B-M Manufacturing Company, Division of Essex Wire Corporation, Logansport, Ind.

Ryan FR Fireball Fighter

The Ryan FR Fireball, Navy fighter plane, uses a combination of reciprocating and reaction power units for propulsion. It was developed to meet the Navy's need for a high-speed, maneuverable, fast-climbing fighter for operation from carriers, and was in production before the end of the war but was not employed in combat.

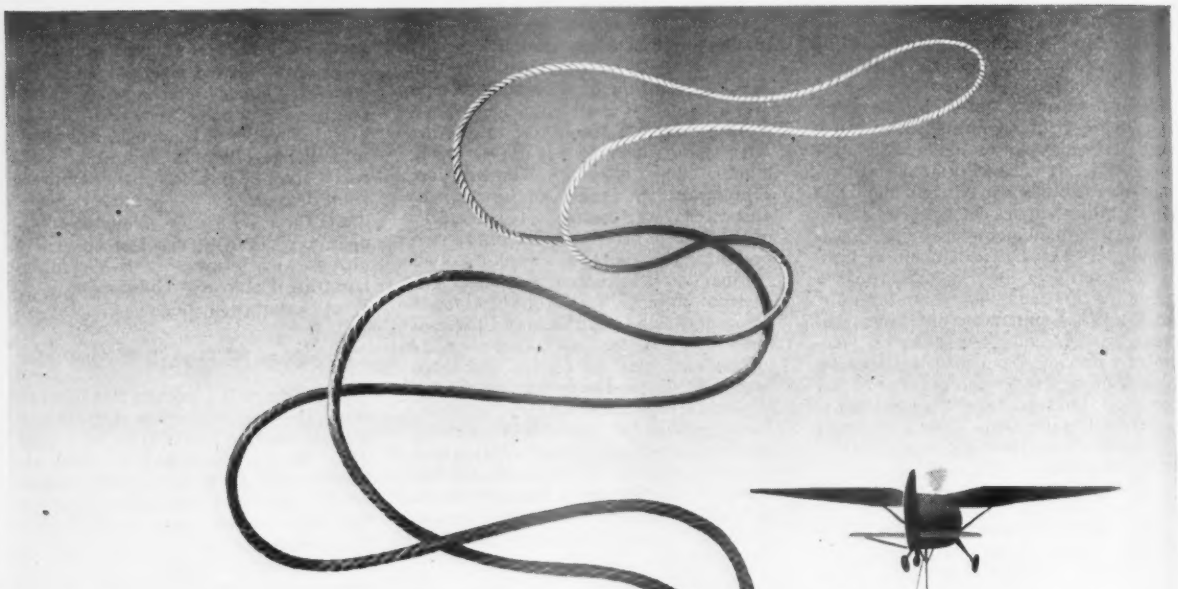
The power combination is a Wright Cyclone radial engine with a three-bladed propeller at the front, and a General Electric thermal jet propulsion engine at the rear. Maximum performance is obtained when the two engines are used in combination but the airplane can be operated on either the conventional or the jet engine independently.

The Fireball is a low-wing, single-seat monoplane with a tricycle landing gear. The air intakes for the jet unit are in the leading edge of the wing near the fuselage. The jet unit itself is enclosed in the after section of the fuselage, with the jet exhaust opening under the tail. Both engines are completely enclosed and all air scoops for the forward engine are within the engine cowling.

The cockpit is located slightly forward of the leading edge of the wing, giving the pilot great range of vision. A jettisonable plastic canopy covers the cockpit and is designed to be deflected from the plane by the air stream when the emergency release is used. An oxygen system for high-flying and equipment to service the pilot's anti-blackout suit are provided. The instrument panel is equipped with subdued red lighting for night flying.

Placement of the cockpit ahead of the wing edge gives the pilot an unusual range of vision. He can look straight ahead without interference from the nose, or look down directly under the wings. Because of the improved forward vision, it is possible to keep the number one arresting wire in view over the nose until the plane has nearly reached the "cut" position before settling down on the deck.

Armament of the FR consists of four 0.50-cal. machine guns, each supplied with 300 rounds of ammunition. The guns can be serviced when the wings are folded. Two 1,000-lb. bombs can be carried under the wings, and detachable rocket-mounting posts may be installed under each outer panel. Steel armor plate and laminated bullet-resistant glass in the windshield front panel protect the pilot.



"SUCCESSFUL PICK-UP OPERATIONS," states All American Aviation Corporation, "frequently mean flying at altitude and visibility minimums which actually represent instrument conditions. Minimum interruption of service plays an important part in Pick-Up operations as well as other types of airline operations." . . . Building a record of 92% completed schedules through some of the most treacherous flying country in the United States, blazing the trail for other Pick-Up operations, All American Aviation has relied many times on the complete high quality instrumentation of their Pick-Up planes to bring pilot, cargo and ship through safely. Kollsman accuracy and dependability can be one of your greatest assets, too. Be sure to write for the Kollsman Aircraft Instruments catalog. It is packed with facts and specifications to help you select the instruments to provide safe, all-around-the-calendar flight. Address: Kollsman Instrument Division, Square D Company, 80-08 45th Avenue, Elmhurst, New York.

KOLLSMAN AIRCRAFT INSTRUMENTS

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Rated at 1,350 hp., the nine-cylinder Wright Cyclone model R1820 engine's output can be increased by water injection. It is reported to weigh less than 1 lb. per hp. and has forged cylinder heads, "W" fins, and a two-stage supercharger. Its fuel economy makes possible a maximum range of 1,500 miles (with droppable tanks), cruising at 207 m.p.h. At full throttle, the reciprocating engine alone gives the plane a speed of 320 m.p.h. It is fitted with a Curtiss Electric full-feathering, three-blade, constant-speed propeller. The General Electric-designed I-16 thermal jet engine alone is stated to be able to propel the plane at approximately 300 m.p.h. Ryan Aeronautical Company.

Cylindric Plug Gage

A recent addition to a line of precision tools is the Dubl Duty cylindrical plug gage. This gage has a light aluminum-alloy collet-type handle that firmly positions a set of wire-type cylindric plug gages. The type of handle enables the user to reverse the gage member after it has worn under the allowable limit and take full advantage of the unused gaging surface that was formerly in the handle. Thus the durability of the gage is increased and the cost per hole gaged is lowered. There are no tapers, no drift pins, and no split handles.

Components are made of high-grade tool steel, hardened, ground, plated, and lapped, supplied from stock in a size range of $^1/_{16}$ in. to 1 in. in increments of $^1/_{16}$ in. Made to a commercial Y tolerance, limits are established at ±0.0005 from the basic figure. Schrillo Aero Tool Engineering Company, Los Angeles.

Close-Tolerance Instrument for Inspecting Fuel-Injection Devices

By the use of a new high-amplification Precisionaire, tolerances held accurate to millionths of an inch in grinding, lapping, superfinishing, inspection, and assembly have been applied to quantity production.

When it was decided to use direct fuel injection of high-octane gasoline in the engines of certain aircraft, unusual production and inspection problems developed at the Eclipse-Bendix plant at Elmira, N.Y. In manufacturing these fuel-injection devices in large quantities with the necessary close tolerances, clearances in this assembly had to be controlled so that the permissible variation of either the hole or the cylindric plunger was ten-millionths of an inch—±0.000005 in.

The development of a high-amplification Precisionaire provided the solution. This flow-type air gage could readily be applied to accurate measurement of either internal or external dimensions to the tolerances required with gaging speed and ease of reading that would permit quick checks of taper, bell-mouth, roundness, and size.

In this extensive application more than 200 gages were used, with a required duplicate performance within three-millionths of an inch. It was necessary to calibrate master ring gages mounted in nonconductive brackets to prevent thermal expansion and incorrect readings caused by the inspector's handling of the rings. These masters were then used to check all the air gages used throughout the grinding, lapping, and inspecting phases of production. The machine operator would use the Precisionaire to check the condition of the hole and determine what corrective adjustments might be required for finishing the hole to straightness within limits. During manufacture the parts were inspected at four successive stages. A single measurement was determinable in less than 2 sec. after the part had been positioned at the location where the measurement was desired.

In order to minimize part losses in grinding and finishing, 16 size classifications, each five-millionths of an inch apart, were established, permitting a total range of part diameters eighty millionths wide. It was still necessary at any size step that the part be round and straight within the ten-millionths limit. However, it became possible for the grinding machine operators to correct parts found to be out of tolerance by discovering the error while the part was still in the machine and grinding to a size class several steps larger. Those parts that were found to be out-of-round in excess of ten-millionths, or that were tapered, were in most cases salvaged by corrective lapping. The Sheffield Corporation, Dayton, Ohio.

Diamond Dresser for Multirib Grinding

Many single-point thread grinders can now be converted to multiribbed wheel work by means of a new semi-automatic diamond dresser. The maker states that in single-point or single-rib grinding, the one rib must bear the entire load, whereas the load is divided among all the ribs of the multi-grooved wheel.

The Sheffield Semi-Automatic Diamond Dresser is mounted between centers of the grinder and is actuated by the driving pin on the face plate. A precision ground cam for the required pitch is mounted upon an accurately ground and lapped spindle and controls the movement of a suitable diamond. The reciprocating movement of the diamond in conjunction with the uniform lateral motion imparted by the leadscrew results in the desired wheel profiling action.

This precision dressing device is recommended by the manufacturer for use on (a) work demanding long lengths of thread and where the breakdown of a single point wheel necessitates making a number of passes; (b) thread gage grinding for elimination of thick first and last threads; (c) maintenance of minimum lead variation; (d) all fine pitch threads over 32 threads per in.; (e) where the wheel is to be dressed at the required helix angle; and (f) where it is desired to traverse grind and the sharp corner and small radii exceed the limits of crush dressing. The Sheffield Corporation, Dayton, Ohio.

Big Bomber "Civilianized"

The British aircraft industry continues to adapt its productive capacity to the speedily changing conditions of the day. Aircraft that have proved their worth in war are being converted to peacetime pursuits, the latest to undergo such a change being the Short Stirling.

This four-engined bomber is being converted into a passenger and freight transport. Loaded to 70,000 lbs., it can carry a pay load of 18 passengers and their baggage (equivalent to 3,960 lbs.), 1,300 lbs. of freight and 3,600 lbs. of mail (a total of 8,860 lbs.) a distance of 1,300 statute miles at a speed of approximately 207 m.p.h., leaving a fuel reserve for a further $2^1/_2$ hours' flying.

There are nine passenger seats on each side of the lined and soundproofed cabin. The cabin is lighted by roof lighting and each passenger has a separate reading lamp. The windows become curtained portholes and a light luggage rack runs the length of the compartment on both sides. Immediately aft of the passenger compartment is a wardrobe and aft of that a galley with vacuum flasks and other kitchen equipment. Still further to the rear are two lavatories, each with a washbasin and mirror.

The freight compartment, which has a capacity of 124 cu.ft., is in the nose. Passengers' baggage is stowed in a space between the main plane spar frames. Mails are carried in the bomb cells in specially designed containers. A maximum of 24 containers can be loaded.

Passengers enter through a door on the port side of the fuselage, but when the Stirling is used for freight only loading is through a large hatch on the starboard side.

Power comes from four Bristol Hercules XVI air-cooled, sleeve-valve radial engines, each of 1,600 hp., driving three-bladed, full-feathering de Havilland propellers. When loaded to 60,000 lbs., the new transport can clear a 50-ft. obstruction in 1,000 yards from the start of its take-off run, and with a total weight of 70,000 lbs. can climb at the rate of 650 ft. per min. from sea level, using maximum climb power, and at 470 ft. per min. on maximum weak-mixture cruising power. Its dimensions are: span, 99 ft. 1 in.; length, 87 ft. 3 in.; height, 22 ft. 9 in.

The addition of the Stirling brings the number of British four-engined air transports now available or under construction to ten. Some of these transports will be built in two separate forms, one for passengers, the other for freight. The Society of British Aircraft Constructors, Ltd.

Great Britain's Output of War Planes Revealed

Gradually the story of the growth in output of the British aircraft industry is being unfolded. It is now revealed that from September, 1939, until the end of the war in Europe, the total production

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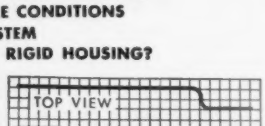

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of British factories was 125,000 airplanes, of 220 different type designations.

More impressive than this figure is that relating to the expansion of the industry—from an average of 730 planes a month in the first four months of the war, to 2,435 a month in 1944. The output shown by numbers does not reflect the total expansion, because in 1940 the production of small trainer aircraft constituted no less than 34 per cent of the entire output, while in 1944 these types made up only 14 per cent of the total figure. Production of heavy bombers, nil in 1939, made up only 0.27 per cent of the 1940 total aircraft output, while in 1944 heavy bombers accounted for no less than 9.7 per cent.

At the peak period in 1944, the total number of persons employed in the aircraft industry was near the 2,000,000 mark, engaged in the manufacture of all types of aircraft, heavy bombers, medium and light bombers, fighters, naval aircraft, trainers, general reconnaissance, air-sea rescue and other types, engines, and all types of accessories and spares.

Figures for engine production have not yet been disclosed. Measuring production by horsepower, output was five-and-a-half times greater than in the first 12 months of the war. Recently, the Rolls-Royce company revealed that during the war years no fewer than 150,000 Merlin engines had been produced and that production in 1943 was nine times that of 1939. This is but one company, whose production of engine spares increased elevenfold in the same period.

The repair of aircraft during the war period absorbed a large proportion of the capacity of the industry and although figures are not complete, not having been recorded until the spring of 1940, it can now be stated that 80,000 airplanes were repaired and put back into service, four for every six new aircraft put into service. In one year, 18,000 aircraft underwent major repair and were returned to the combat lists, the average time for repair being 8 weeks per casualty.

An idea of the production of Great Britain's combat aircraft may be gathered from the manufacturers' own figures. These show the following output for the various types: Spitfire, 21,000 (including Seafires for the Navy and 305 Spitfires built before the war); Hurricane, 14,000 (including 1,500 built in Canada); Wellington, 11,391; Anson, 10,000; Lancaster, 9,000; Halifax, 6,000; Mosquito, 6,000; Beaufighter, 5,650 (including 250 built in Australia); Blenheim, 5,400; Oxford, 5,000; Swordfish, 2,399; Beaufort, 2,200 (including 700 built in Australia); Battle, 1,160; Bolingbroke, 700 (all built in Canada); Fulmar, 650.

Sir Stafford Cripps, when Minister of Aircraft Production, gave some interesting facts and figures regarding the production of large aircraft in Great Britain. He stated that, at peak output, the Handley Page Halifax four-engined bomber was being made in no fewer than 41 factories and dispersal units, aggregating between 7,500,000 sq.ft. of productive area and employing 51,000 men and women workers. The Society of British Aircraft Constructors, Ltd.

Additional Data about a New Air Liner

More details of the Miles Marathon, which is expected to make its first test flight before the end of the year, are now available. This aircraft, a high-wing, all-metal, four-engined 14-seat air liner, can be rapidly converted to carry 20 passengers. Also, with few structural alterations, it is being built as a freighter.

The Miles company has devised its own system of pressurization and air conditioning. The air is warmed and passes into the cabin through ducts under the floor leading to screened grilles set at intervals in the wall just above floor level. Used air is extracted through ventilators in the roof and discharged into the atmosphere. This system assures a continuous change of air.

The flight deck has accommodations for two pilots and a third crew member if necessary. Engine, propeller, undercarriage, flap, and trimming-tab controls are on a central mounting between the two pilots and so distributed that each is readily accessible from either seat.

As a safeguard against engine failure at take-off or during flight, a device has been fitted by which the pilot can offset the fins either way to counteract the effects of unequal thrust on one side. The push-pull type of control column has been adopted and the rudder bars are adjustable to suit the needs of individual pilots; the pilot merely places his feet on the spring-loaded foot rests, lifts a plunger by means of a flexible control from the dashboard, moves the foot rests to the most comfortable position, then releases the plunger which drops securely into the nearest stop and locks itself.

The first Marathons will have four six-cylinder, air-cooled, geared and supercharged de Havilland Gipsy Queen engines, each rated at 330 hp. for take-off. Later, two 850-hp. Armstrong Siddeley Cougar air-cooled radials, or four 500-hp. Alvis Leonides air-cooled radials may be available.

It is believed that this is the first British aircraft to incorporate thermal deicing, which has been made independent of the engines. The main unit consists of three combustion heaters with a normal duration of 3 hours but through a connection with the main fuel supply they can be kept going till the tanks are almost dry. Their rate of consumption is only 0.6 gal. per hour. One of them warms the cabin air.

Preliminary details of the Marathon show that its span is 65 ft.; length, 51½ ft.; height, 13¼ ft.; cabin volume, 775 cu.ft.; and volume of baggage and freight compartments 350 cu.ft. Total weight, empty but with all fittings, is 9,914 lbs.; and the loaded weight is 15,000 lbs., providing 3,646 lbs. for passengers, freight, and mail. The Society of British Aircraft Constructors, Ltd.

Aviation Gasolines

A new line of aviation gasolines is designed to increase permissible power and lower engine-maintenance costs.

Grade 80, designed for the engines of private planes, is a clear gasoline having a full 80-octane rating that is obtained without the addition of tetraethylead. It is claimed that this type of fuel, unavailable before the war, will materially reduce top-cylinder maintenance and allow designers of small engines to improve performance without increasing engine size and weight. It will also provide added protection against detonation for the private plane engines now in use which were built to use 73-octane gasoline.

Grades 91 and 100, the gasolines used largely for commercial and military operations, possess new qualities. Higher permissible take-off power and lowered lead content are the prime factors derived from this higher quality. Standard Oil Company of New Jersey.

Tapping "Blind" Holes

Cartridge-tapping consists of tapping into and through a hard, plastic, extrudable, Tap-Cartridge that has been introduced, either automatically or manually, into the drilled hole. This process is reported to be applicable to any material.

The materials used in the manufacture of the cartridges are such that, in nearly all cases, the portion below the end of the tap at its reversal point adheres to the material in the flutes of the tap and is withdrawn with the tap. If in some operations any remains, it can be removed by any standard hot-water wash or vapor degreasing. The material is noncorrosive. Any standard taps, other than "gun" taps that throw chips ahead of the tap, may be used.

Tap-Cartridges are formed by special extrusion machines through a die invented for the purpose when it was found that the usual type dies would not produce the desired results. Tap-Cartridge, Inc., Cincinnati.

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